STOLPORT RESEARCH AND APPLICATIONS

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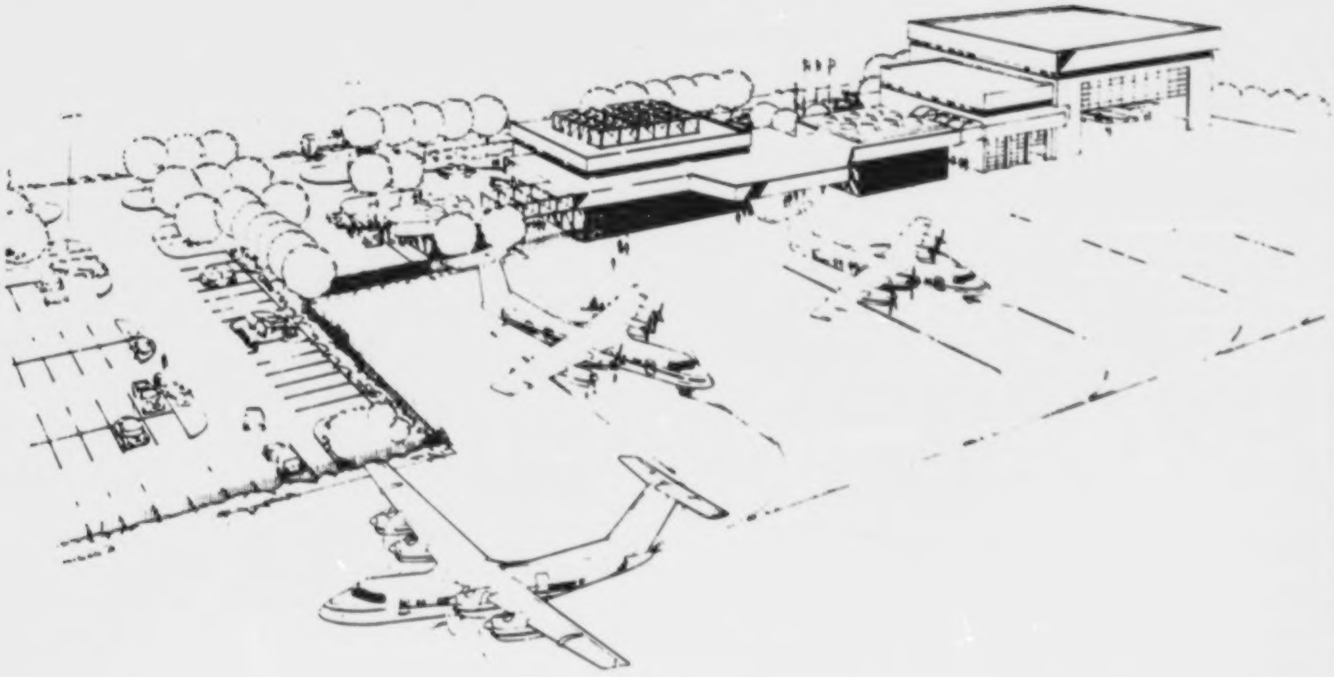

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STOLPORT RESEARCH AND APPLICATIONS

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by

IBI GROUP
in association with
CANAVIA TRANSIT INC.

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February 1985

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17 Abstract

The purpose of this study is to assist private short take-off and landing (STOL) commuter airline operators and those involved in planning STOL airport facilities. It focuses on a number of issues, including ground-side facilities and operational requirements at single operator airports and the potential economies arising from integrating ground and air transportation services, and comments on the applicability and currency of existing STOL and conventional (international) airport facilities standards suitable for adaptation at private STOLports. Airside and groundside facility standards are developed, addressing requirements for aircraft maneuvering surfaces, passenger terminal complexes, aircraft maintenance facilities, ground transportation systems and airport maintenance. Effects of variations in unit space standards, level of service, passenger characteristics and demand forecasts, airline schedules and passenger processing procedures are also addressed; as are requirements for communications systems, meteorological facilities, and such infrastructure considerations as administration, storage and emergency services. Four STOLport facility concepts are evaluated for use at privately-owned and operated sites at Toronto Island, Ottawa and Montreal. The study shows that considerable reductions in requirements for passenger terminals and airport parking could be achieved through a total systems approach involving the direct transfer of STOL passengers between city centre pick-up points and the aircraft, using a mobile terminal in the form of a computer-equipped bus. The carrier would benefit from lower costs for airport facilities, while passengers would benefit from an economic, convenient door-to-door service.

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17. Résumé

Cette étude a pour but d'aider les compagnies privées de transport aérien de troisième niveau exploitant des ADACs, ainsi que les responsables de la planification des ADACports. Elle aborde, entre autres sujets, l'aménagement des installations côté ville et les besoins opérationnels des ADACports n'accueillant qu'une seule ligne aérienne, ainsi que les économies possibles résultant de l'intégration des services de transport aérien et terrestre. Après avoir indiqué dans quelle mesure et à quelles conditions les normes actuelles concernant les aérogares conventionnelles et les ADACports peuvent être adaptées au secteur des ADACports privés, elle propose des normes concernant les installations côté piste et côté ville de ces derniers: aires de manoeuvre, aérogares, installations d'entretien, systèmes de transport terrestre, et aussi l'entretien aéroportuaire. Puis, elle étudie l'effet des variations dans les normes de dimensionnement, le niveau de service offert, les caractéristiques des voyageurs et les prévisions de trafic, sans oublier les horaires et les formalités de traitement des voyageurs. Elle analyse ensuite les besoins en matière de systèmes de communication, de services météo et d'autres points comme l'administration, les installations d'entreposage et les services de secours. Elle évalue aussi quatre projets d'ADACports privés qui pourraient être implantés à Ottawa, à Montréal et à l'aéroport Toronto Island. Une des conclusions de l'étude est que l'on pourrait considérablement réduire la superficie des aérogares et des terrains de stationnement attenants en établissant un système de liaison terrestre qui prendrait en charge les voyageurs au centre-ville et les amènerait directement à la porte de l'avion, utilisant pour cela un véhicule spécial équipé d'un terminal d'ordinateur et des autres aménagements nécessaires pour remplir toutes les formalités de départ: réservations, enregistrements, billets, etc. De cette façon, le transporteur aérien verrait ses charges d'aéroport baisser, tandis que les voyageurs bénéficieraient d'un service porte-à-porte économique et par-dessus tout commode.

18. Mots-clés
Aérogare, ADACport, faisabilité, piste d'atterrissage, DASH-7 aéronef, économie, normes, installations aéroportuaires, opérations aéroportuaires, lutte contre l'incendie. sauvetage

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TABLE OF CONTENTS PAGE

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Objectives & Scopes 5
1.3 Methodology 5
1.4 Literature Search 6

2.0 SYSTEM DEFINITION AND TRAFFIC DEMAND 8
2.1 Geographic Coverage 8
2.2 Local Factors 8
2.3 Groundside Alternatives 12
2.4 Traffic 13
2.5 Peak Period Schedule 18

3.0 AIR TRAFFIC CO TROL AND AIRFIELD ZONING 22
3.1 Air traffic Control 22
3.2 Meteorological Facilities 22
3.3 En Route and Terminal Navaids 22
3.4 Electronic Landing Aids 22
3.5 Visual Landing Aids 23
3.6 Airfield Zoning 23

4.0 AIRCRAFT MOVEMENT SYSTEM 27
4.1 Runway Requirements 27
4.2 Taxiway Requirement 33
4.3 Aprons 33

5.0 PASSENGER HANDLING FACILITIES 34
5.1 Background 34
5.2 Passenger Attributes 34
5.3 Planning Standards Availability 35
5.4 Planning Considerations 35
5.5 Enplaning System Alternatives 38
5.6 Deplaning System Alternatives 39
5.7 Baggage Handling System Alternatives 39
5.8 Concessions 40
5.9 Parcel Service 40
5.10 Level of Service 41
5.11 Passenger Terminal Space Requirements 42
5.12 Passenger Terminal - Impact of Delays 46
5.13 Interaction with STOLport Layout 46

6.0 GROUND ACCESS 48
6.1 Background 48
6.2 Air Passenger Traffic Demand 48
6.3 Choice of Ground Travel Mode 48
6.4 Ground Access System Demand 50
6.5 STOLmobile Requirements 50
6.6 Vehicle Traffic Demand 51
6.7 Parking Demand 54

TABLE OF CONTENTS PAGE

7.0 AIRPORT SERVICES AND AIRPORT SUPPORT 56
7.1 General 56
7.2 Apron Services 56
7.3 Airport and Airfield Maintenance 58
7.4 Building Requirements 59

8.0 AIRCRAFT MAINTENANCE 61
8.1 General 61
8.2 Program Content 61
8.3 Maintenance Hangar Considerations 62
8.4 Building Alternatives 64
8.5 Support Areas 64

9.0 EMERGENCY SERVICES 68
9.1 Emergency Planning 68
9.2 Level of Service - All Types of Emergencies 69
9.3 Clothing - CFR 72
9.4 Vehicles and Ancillary Equipment - CFR 74
9.5 Ancillary Equipment 78
9.6 Supplies - CFR 78
9.7 Extinguishing Agents 79
9.8 Considerations for Foam Carpets 80
9.9 Facilities Requirements, Access Routes 80
9.10 Communications 81
9.11 Security 81
9.12 Special Purpose Facilities 82
9.13 Maintenance 82
9.14 First Aid Services 82
9.15 Security Services 84

10.0 OPERATIONS CENTRE 86
10.1 General 86
10.2 Building Requirements 86
10.3 Communications 87

11.0 EVALUATION AND APPLICATION OF ALTERNATIVES 91
11.1 Alternative Layouts 91
11.2 Building Area Requirements 96
11.3 Concept Evaluation 98
11.4 Site Application 101
11.5 Observations 102

APPENDIX A - Bibliography

APPENDIX B - Bibliography - Emergency and Security Services

APPENDIX C - Glossary of Terms

LIST OF TABLES PAGE

Table 1. Multimodal Travel Times (Hours) 10
2. Forecast of Annual STOL Traffic Demand (Mature System) 14
3. Average Weekday One Way Person Trips (Mature Market) 15
4. Resident Passenger Origins on Planning Peak Day 17
5. Planning Peak Day Interzonal Changes (Person Trips) 17
6. Weekday Schedule (Mature Service) 19
7. Saturday and Sunday Schedule (Mature Service) 19
8. Maximum Allowable Take-Off Weights Balanced Runway Concept 30
9. Maximum Allowable Take-Off Weights Unbalanced Runway Concept 30
10. Landing Runway Length Rwquirements 31
11. Aircraft Net Take-Off Flight Path Co-Ordinates 32
12. Congestion Standards 42
13. Passenger Terminal Building Requirements 43
14. Modal Choice Ground Access System 49
15. Modal Choice Distribution By Trip End 49
16. Derived Modal Choice C -Efficients 50
17. Planning Day Road Access System Demand by Mode 50
18. Estimated STOLmobile Loadings 51
19. Assumed Modal Split Peak Planning Day 52
20. Planning Day Peak Hour Vehicle Flows 53
21. Trip Duration and Length of Stay 54
22. Parking Requirements/1000 Departing Residents 55
23. Effect of Non-Returning Factor on Parking 55
24. CFR Primary Intervention Vehicle Requirements 76
25. Vehicle Capacity Requirements 77
26. Proposed Vehicle and Supplies Substitutions 78
27. Requirements for Runway Foaming 80
28. Operations Centre Space Requirements 88
29. Concept Evaluation 98

LIST OF FIGURES

		PAGE
Figure	1. Mobile Terminal Concept	4
	2. STOL System Route Program	9
	3. Protection Surfaces	24
	4. Runway Design Terminology	29
	5. Alternative Passenger Terminal Layouts	44
	6. Dash 7 Work Areas	63
	7. Alternative Hangar Layouts	65
	8. De Havilland Hangar Concept	66
	9. Emergency Services Response Capability	70
	10. Comparison of Extinguishing Methods	73
	11. CFR Facility Requirements	75
	12. Operations Centre Layout	89
	13. Centralized STOLport Concept	92
	14. Decentralized STOLport Concept	93
	15. Modular STOLport Concept	94
	16. Zero Amenity STOLport Concept	95

1.0 INTRODUCTION

1.1 Background

History

In recent years there has been a significant and steady growth in the number of short take-off and landing aircraft (STOL) operations by commercial carriers. Initially much of this activity involved low volume services to remote locations where construction of conventional runways was either uneconomic or impractical. STOL services were inaugurated in Norway, the French Alps, the United States Rocky Mountains and in Northern Canada. These early operations demonstrated the technical feasibility and safety of the STOL concept.

The success of a Transport Canada STOL demonstration project in 1974-76 created additional interest worldwide in establishing high capacity commuter services using STOL aircraft such as the de Havilland Aircraft of Canada Ltd. Dash 7 and Twin Otter.

Transport Canada Demonstration Project

The Transport Canada demonstration project was designed to determine the practibility of a high frequency service accommodating primarily city centre orientated business travellers. The Montreal to Ottawa route was selected for the experiment and the aircraft chosen was the de Havilland Twin Otter.

The system elements included the following:

1. de Havilland Twin Otter aircraft in an 11 seat configuration;
2. Special purpose STOLport facilities at both Montreal and Ottawa;
3. Integrated STOLmobile services which provided flight specific limousine service between the STOLports and the city centres at no extra charge;
4. A high frequency air service which, reduced travel time to below that available on any of the competing modes, including conventional aircraft (CTOL), commuter rail, highway bus and private automobile.

The experiment showed that a high quality city centre-to-city centre commuter STOL service could attract passengers from all the conventional transportation modes operating in the corridor at fare levels equivalent to those charged by conventional air carriers for the same distance.

The demonstration project showed that Central Business District (CBD) to CBD STOL commuter services were technically feasible and that acceptable aircraft load factors could be achieved. The commercial viability of a stand-alone STOL commuter service was not demonstrated since the experiment incurred significant operating deficits primarily because of its experimental nature and the low capacity of the aircraft used. However, the results indicated that a privately operated service using larger aircraft might be commercially viable.

Existing Standards

The STOL demonstration project showed that the traffic characteristics and operating standards, and level of service expected by system users are very different for STOL than those for conventional air services (CTOL). A number of aviation organizations such as the International Civil Aviation Organization, the Canadian Ministry of Transport, the Federal Aviation Administration (U.S.) and the Civil Aviation Authority (U.K.), have recognized the unique characteristics of STOL operations and have published standards primarily dealing with airfield zoning, flight operations and aviation safety. In Canada, provisional standards have also been developed for some groundside facilities. These, have been largely based on experience gained during the Transport Canada STOL demonstration project referred to earlier.

The underlying assumption in many of the existing standards is that the facilities to which the criteria apply would be publicly operated and would be required to accommodate a number of carriers in the same manner as publicly operated conventional airports. It is believed there is considerable scope for increasing the cost effectiveness of some of these standards particularly at private airports designed to accommodate a single carrier operating only one type of STOL aircraft.

Canavia/City Center Concept

The technical success of the STOL experiment coupled with the widely demonstrated public acceptance of STOL led to considerable private sector interest in operating a STOL commuter service linking the cities of Toronto, Ottawa, and Montreal. Suitable STOLport sites exist at all three cities; in the case of Montreal and Ottawa, some facilities used during the demonstration project are still in existence; in the case of Toronto, the Toronto Island Airport can readily accommodate the additional facilities required for STOL operations provided that Microwave Landing Systems (MLS) are installed.

The interest shown in STOL by the private aviation sector and the public encouraged the Canadian Transport Commission (CTC) to consider proposals from private industry to operate a stand-alone commuter STOL service between the three cities mentioned earlier, using Dash 7 aircraft manufactured by the de Havilland Aircraft of Canada Ltd.

The successful applicant, City Centre Airways, (Canavia) carried out extensive studies into the fixed facility and operational requirements for the proposed service.

The service envisaged by this carrier would require the reinstatement and upgrading of two of the STOLports used during the STOL demonstration project (Victoria STOLport in Montreal and Rockcliffe Airport in Ottawa) and the development of STOL facilities at the Toronto Island Airport which now accommodates large volumes of general aviation traffic and some commuter traffic. The service would utilize 50 passenger de Havilland Dash 7 aircraft.

Preliminary analysis by the carrier indicated that the profitability of the system could be significantly improved by optimizing the service as a whole including the operation of the aircraft, the design of the airports and the ground access system (including transport vehicles and parking). Furthermore, standardizing on a single aircraft type and operating within a fixed system could result in significant reductions in peak period traffic fluctuations. The use of the STOLmobile for airport access also offers opportunities for controlling passenger traffic build-up in the passenger terminal building resulting in lower capital and operating costs.

The Canavia/City centre proposal assumes that the majority of the facilities required at the Montreal and Ottawa STOLports would be owned and operated by the carrier. This would allow capital and operating costs to be optimized over the entire system including airside and groundside operations. Because of the concentrated city centre markets which the service is intended to serve, it would be possible to locate some passenger facilities in the Central Business District (CBD) in existing buildings and to provide a flight specific bus service between the city centres and the airports.

The Mobile Terminal Concept

In order to test public acceptance of curbside passenger pick up Canavia successfully staged an experiment involving "STOLmobiles" to Toronto Island Airport in November 1983. This experiment showed that a dedicated bus service, could reduce travel and passenger processing times by one half by providing a curb-to-aircraft shuttle to transfer passengers between the city-core and a waiting aircraft. The groundside trip took approximately 20 minutes including the time spent on the ferry, and eliminated pre-flight processing at the airport.

Part of the research documented in this report was undertaken to establish whether such a mobile terminal service could be offered as permanent part of the STOL service at all airports. Such a service would reduce overall trip time for passengers, and would reduce or eliminate requirements for passenger terminal facilities, ground side passenger and visitor vehicle parking, and pre-boarding staff at the airport, with obvious potential cost savings. The concept of zero amenity passenger terminal facilities -- (no on-airport terminal building) was examined in this Study in the context of Ottawa and Montreal STOLports, which otherwise would require considerable facility restoration and new construction. An outline drawing of the proposed concept is shown in Figure 1.

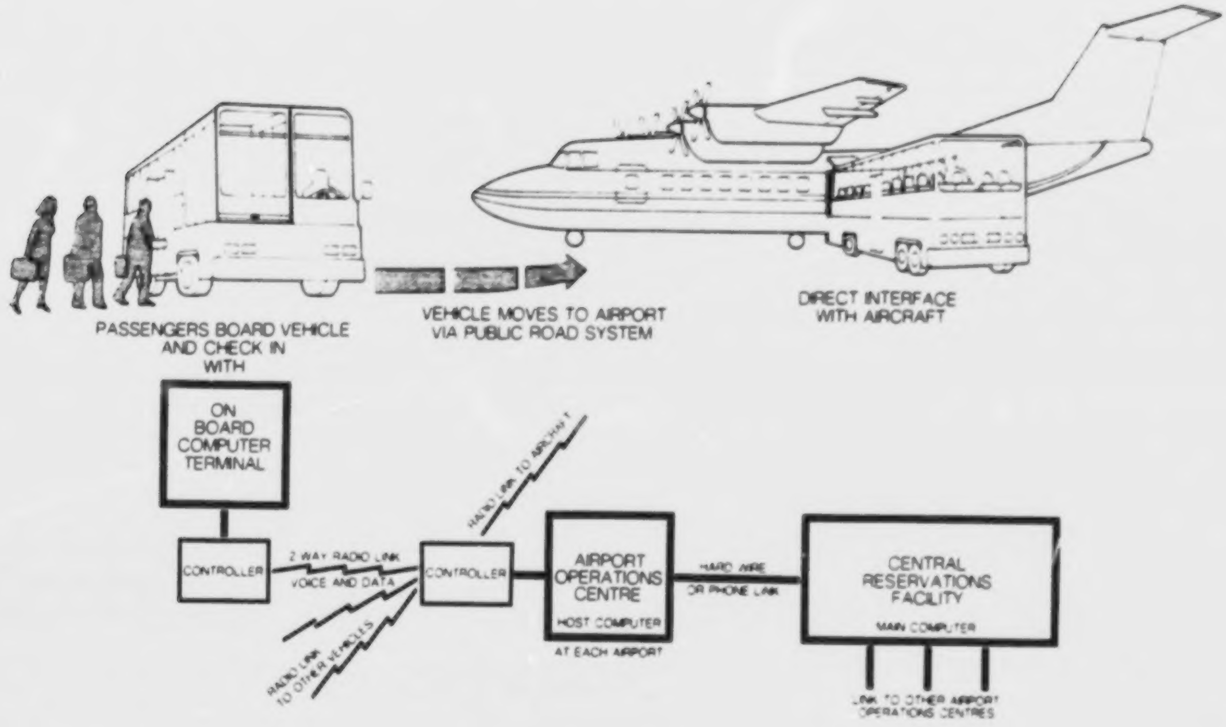

PASSENGERS BOARD VEHICLE AND CHECK IN WITH
VEHICLE MOVES TO AIRPORT VIA PUBLIC ROAD SYSTEM
DIRECT INTERFACE WITH AIRCRAFT
ON BOARD COMPUTER TERMINAL
CONTROLLER
2 WAY RADIO LINK
VOICE AND DATA
CONTROLLER
RADIO LINK TO AIRCRAFT
RADIO LINK TO OTHER VEHICLES
AIRPORT OPERATIONS CENTRE
HOST COMPUTER
AT EACH AIRPORT
HARD WIRE
OR PHONE LINK
CENTRAL RESERVATIONS FACILITY
MAIN COMPUTER
LINK TO OTHER AIRPORT OPERATIONS CENTRES

figure 1

MOBILE TERMINAL CONCEPT

Crash and Rescue Facilities

Another major area of research covered in this study dealt with Emergency Services which included Crash, Firefighting and Rescue (CFR). Major factors examined in this context were: (a) the possibility of placing greater reliance on emergency facilities already available in communities adjacent to the airports, (b) whether the small area of STOLports and small size of the Dash 7 aircraft combined could result in reduced CFR vehicle capacity and performance requirements.

Private Sector Financing Constraints

Because of the rigid financial criteria associated with private sector investment, physical solutions designed to permit flexible staged capital investments in parallel with traffic and revenue growth were also examined.

1.2 Objectives and Scope

The principal objectives of this study were:

- to discover methods of improving the effectiveness of inter-city transportation in Canada and means to support development in the air transport and aircraft manufacturing sectors;
- to review existing recommendations, guidelines and requirements for airport facilities and services to determine their relevance to the development of Canadian STOLports, and to establish improved designs for private sector adaptation.

The scope of the research included application of the findings to three selected STOLports sites at Toronto, Montreal and Ottawa.

Although the primary aim of the research was to evaluate options for effective passenger transfer by STOL, identification of secondary benefits such as the potential for economic spin-offs to Canadian industry were also investigated.

1.3 Methodology

The following approach was followed:

A Comprehensive Literature Search Utilizing Computer, which identified international studies and standards (in final or draft format) relating to STOLport facilities design and operation was undertaken. Information from organizations such as Transport Canada, the Transportation Development Centre, FAA, ICAO, IATA, de Havilland and CAA was reviewed.

Review of Existing Standards and Pertinent Studies. Following the literature search and review of available materials, an assessment was made of the applicability and currency of all standards and studies suitable for STOLport design. It focussed on airside systems, auxiliary crash, fire-fighting and rescue requirements, passenger terminal facilities and ground transportation requirements.

Development of Groundside and Airside STOLport Facilities Requirements. Generalized requirements for aircraft manoeuvering surfaces, passenger terminal buildings, aircraft maintenance, ground transportation and airport maintenance facilities were determined. These standards defined geometry, level of service, unit space requirements and the interrelationship of space and airport activities. Requirements for administrative space, communications and meteorological facilities were also addressed.

Appreciation of STOLport Planning Standards to Specific Sites. Attention was given to site specific considerations, including the effect of traffic schedules, peaking, traffic delays, duration of peaks, level of service, and their interaction with space standards. The impact of site geography was also addressed.

Development and Evaluation of Optional Solutions. On the basis of developed standards, specific facility solutions for private sector operations were developed. The specific elements included:

- runways, taxiways, aprons
- the passenger terminal complex
- aircraft and airport maintenance
- ground access and parking facilities

Four airport building concepts were developed and evaluated as part of the research, these were:

1) A centralized concept, where all functions are housed within a single structure;

2) A decentralized concept, where each function is housed in its own structure;

3) An integrated modular concept, where functions are housed in individual structures, yet integrated within an expandable, common complex.

4) Zero amenity concept, where all passenger processing would take place offsite in a fixed or in a computer equipped mobile terminal capable of transferring passengers and baggage directly to an aircraft.

1.4 Literature Search

In order to ensure the comprehensiveness of the technical assessment, a literature search of several computerized data banks was conducted through the Transportation Development Centre Library initially. Information on STOLport facility design and operation was obtained from organizations such as Transport Canada, the U.S. Department of Transportation (FAA), the British Civil Aviation Authority (CAA) and International Civil Aviation Organization (ICAO). It was reviewed for applicability, comprehensiveness and currency.

The search identified a far greater number of documents than could be reviewed and assessed in detail given the resources of the project. In light of this a limited listing of STOLport standards and studies is provided in Appendix A-1 for reference purposes.

2.0 SYSTEM DEFINITION AND TRAFFIC DEMAND

2.1 Geographic Coverage

The STOL system researched will link three major Canadian urban centres, Toronto, Montreal and Ottawa. The Montreal-Ottawa leg of the service will duplicate the Transport Canada sponsored STOL demonstration service of 1974 to 1976.

The basic concept for the STOL system is that it should provide a city centre to city centre link between cities situated within 90 to 260 air miles of one another. Since each route in the system would operate independently, the total system can be considered as consisting of a series of two city links, each route having a unique level of service based upon its traffic demand and its geographical and operating characteristics.

An existing airport facility will be upgraded in each city to meet the requirements of a scheduled commercial STOL service. The proposed STOLport for Toronto is the Toronto Island Airport, which is currently operating primarily as a general aviation airport with some secondary scheduled commuter services to a number of small Ontario communities and to Ottawa. The Montreal STOLport will be located at the site of the former demonstration STOLport, and the Ottawa facility will be located at Rockcliffe airport; the same airport as was used during the demonstration project. The proposed route structure is shown in Figure 2.

The air mile distances for the three routes obtained from standard aeronautical charts are as follows:

Route Characteristics

Route	CTOL Traffic (Annual Passengers)	Flying Distances (Air Miles)	Block Time (Hours)
Toronto/Montreal	1,127,000	260	1.3
Toronto/Ottawa	575,000	193	1.0
Ottawa/Montreal	49,000	90	0.6

2.2 Local Factors

All three proposed STOLports are located in close proximity to the respective downtown business districts which they are primarily intended to serve. The metropolitan populations of Toronto, Montreal, and Ottawa/ Hull, markets for this service, are 3.0, 2.8 and 0.7 million people respectively. The approximate distances from the CBD to the airport are as follows:

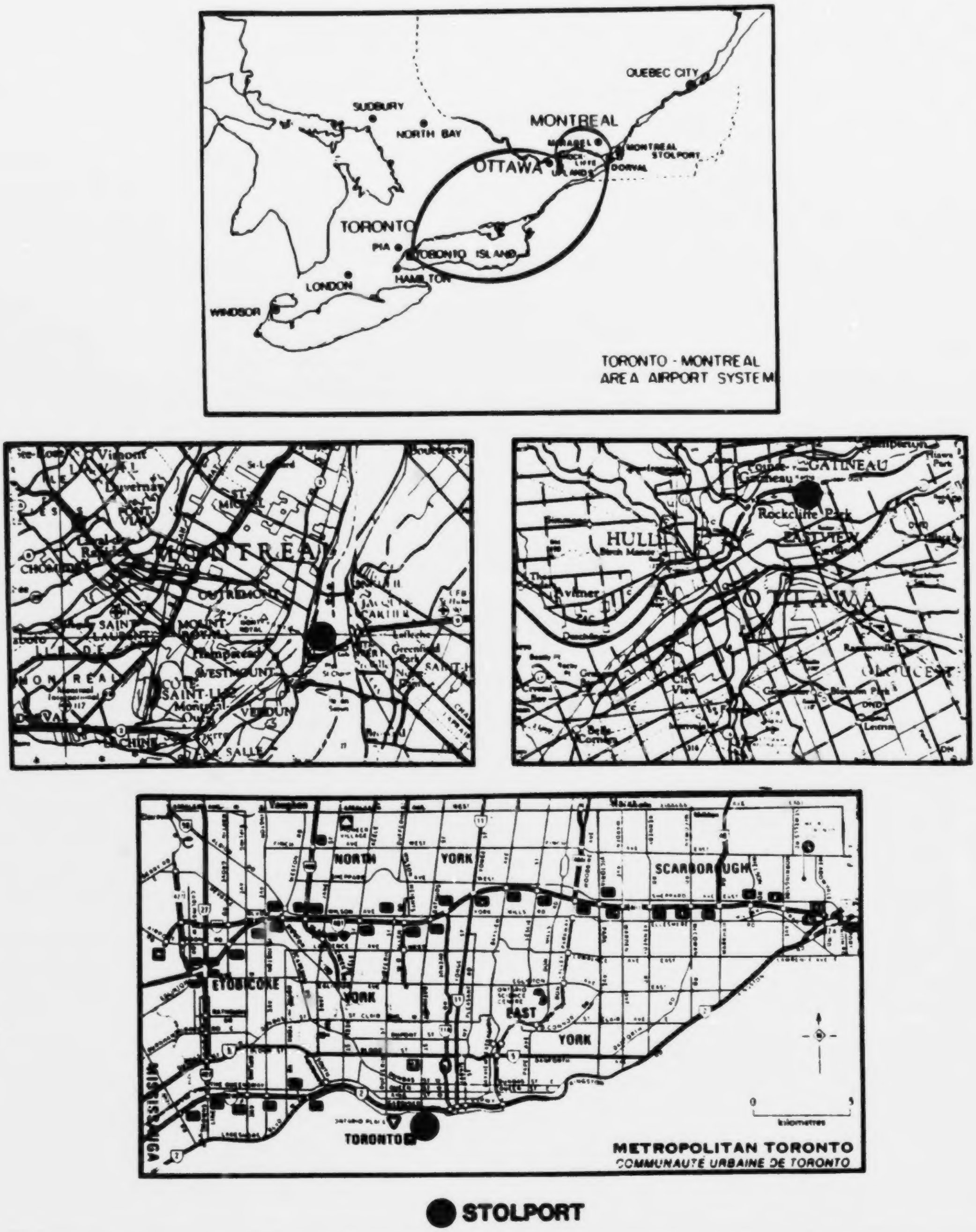

QUEBEC CITY
SUDBURY
NORTH BAY
MONTREAL
MIRABEL
MONTREAL STOLPORT
DORVAL
OTTAWA
TORONTO
PIA
TORONTO ISLAND
HAMILTON
LONDON
WINDSOR
TORONTO - MONTREAL AREA AIRPORT SYSTEM
MONTREAL
OUTREMONT
SAINT-LAURENT
MONT-ROYAL
WESTMOUNT
VERDUN
LACHINE
GATINEAU
HULL
Rockcliffe Park
EASTVIEW
OTTAWA
Aylmer
GLOUCESTER
NORTH YORK
SCARBOROUGH
ETOBICOKE
YORK
EAST YORK
TORONTO
0
5
kilometres
METROPOLITAN TORONTO
COMMUNAUTÉ URBAINE DE TORONTO
● STOLPORT

figure 2

STOL SYSTEM ROUTE DIAGRAM

CBD TO STOLPORT DISTANCES

City	Airport Location	Distances (Kilometres)	Nominal Access Time From CBD (Minutes)
Toronto	Toronto Island	2.5	15
Montreal	Victoria Car Park	3.0	10
Ottawa	Rockcliffe Airport	5.0	10

A number of other transportation services offering a reasonably high level of service are already available on the three routes under consideration. These options include private automobile, rail, bus, or conventional aircraft (CTOL). Trip times by these and by STOL, between the point of departure, (the city centre or representative transportation terminal) and the desired destination are presented in Table 1.

Route	Bus (Terminal /Terminal)	Automobile (CBD/CBD)	Rail (Station /Station)	CTOL (Airport /Airport)	STOL (Future) (CBD/CBD)
Toronto /Montreal	6.5 (0.2)*	6.5	4.5	1.2 (0.8)	1.7
Toronto /Ottawa	5.0 (0.2)	5.0	5.5 (0.3)	0.8 (0.7)	1.4
Montreal /Ottawa	2.5 (0.4)	2.5	2.0 (0.3)	0.5 (0.6)	0.9

Table 1 Multimodal Travel Times (Hours)
(*Numbers in brackets indicate the approximate additional time required to access the terminus from the CBD)

The selected sites for the Toronto and Montreal STOLports are well located relative to the respective city centres in terms of distance, however, reaching the Toronto Island site involves a short ferry crossing. The proposed siting of all three STOLports is shown on Figure 2.

At Ottawa, two locations other than Rockcliffe Airport were examined. One was Gatineau Airport which lies just outside the City of Hull on the north side of the Ottawa River, and the other was the Ottawa International Airport. The factors favouring the selection of Rockcliffe included:

- easier identification with the STOL service by passengers;
- stand-alone operations;
- marginally reduced travel times by road.

The introduction of STOL services at Ottawa International Airport would probably require the least capital investment since the scale of operations envisaged would not significantly increase demand on existing facilities. This option was rejected however, since it would have been impractical to segregate STOL operations, from CTOL operations, particularly passenger handling. Joint airport operations would make it difficult to take advantage of the capability of STOL to increase passenger convenience - its main selling feature.

Toronto Island STOLport

Toronto Island Airport is currently controlled by the City of Toronto and operated by the Toronto Harbour Commissioners. In terms of aircraft movements, it is one of the busiest airports in Canada but the majority of these movements are by light general aviation aircraft on recreational and training flights. The airport operates under day and night visual flight rules and there is little prospect for the installation of precision approach aids of the Instrument Landing System (ILS) type because of the presence of high obstacles on one of the main approach paths and within the missed approach protected area. At present, jet aircraft operations are banned. Due to the steep approach slopes possible with STOL aircraft precision approachs using a microwave landing system (MLS) will be possible. The minima associated for such a system are currently estimated at one kilometre horizontal visibility and 90 metre ceiling.

The mainland opposite the airport is currently administered by Harbourfront, a Federal Government agency. The land of greatest interest to STOL operations are those opposite the Western Gap including the airport parking lot and its peripheral land. Undeveloped land in the vicinity will have a total area of approximately 2 hectares. It is to become a public park so that parking for STOLport patrons will be very restricted. Commercial parking is envisaged to maximize parking availability for air passengers.

The only surface transportation link between the mainland and the airport is a small ferry operating on a 15 minute schedule. It is capable of carrying a standard 40 passenger bus and two automobiles at the same time. The service can probably be upgraded to provide a 10 minute service frequency.

The intended STOL operations are completely compatible with the proposed role for this airport.

Montreal STOLport

The proposed location for the Montreal STOLport is the Victoria carpark site previously utilized by the Transport Canada STOL demonstration service. Site constraints limit the primary runway length to approximately 800 metres which is adequate for DASH 7 operations but cannot accommodate aircraft requiring longer runways. A high level hydro transmission line crosses the western approach to the STOLport, and restricts take-offs in the easterly direction to DASH 7 type performance aircraft.

The location is a former garbage fill site which is still active. This activity results in continuing settlement and methane gas generation. Both of these problems have been extensively investigated prior to, during and since the STOL demonstration project, and the consensus is that the safe control of gas emission is practical. A passive approach to runway improvement is envisaged, whereby the existing runway will be retained and differential settlements will be corrected by periodic resurfacing with hot mix asphaltic concrete.

The airport would be operated as a private facility for STOL services only. Under current zoning constraints, the only commercial aircraft which can be accommodated is believed to be the de Havilland Dash 7.

Rockcliffe Airport

The Ottawa STOLport would be sited at Rockcliffe, previously a Department of National Defence airport. This airport is currently in the process of being acquired by the National Capital Commission and will be the site of the National Aeronautical Museum. It is intended that present flying club activities remain on the airport but at a new location. Discussions with the National Capital Commission indicate that commuter STOL operations would be compatible with the role envisaged for the airport and studies are underway by Canavia to develop an acceptable site plan for the STOL passenger terminal complex and associated facilities.

Access to the airport would initially be along the existing street system, however, in the longer term, connections would be made to a proposed parkway located at the southern boundary of the airport.

The buildings originally constructed for the STOL demonstration project have since been assigned new uses necessitating the provision of new facilities for the STOL operations.

2.3 Groundside Alternatives

The major assumptions regarding ownership of facilities and system operations for the study were:

(1) STOL facilities at all airports would be owned and operated by a single private carrier (in the case of the Montreal STOLport complete control of the airport would be by its STOL operator).

(2) In all cases, the passenger terminal complex and STOLmobile services would be designed for single carrier operation.

(3) All flight operations would be shuttle services between each airport pair. No interlining of either passengers or baggage would be provided for.

(4) Mandatory security checks may be waived because the service is domestic, involves small passenger loads and short stage lengths.

Based on these assumptions, four airport operating concepts were developed, differing primarily as to the manner in which arriving and departing passengers would be handled. The options examined were:

1. Zero facilities option - where all passenger processing would take place off the airport with only emergency shelter available near the aircraft. Passenger check-in and baggage claim facilities would either be made available at a central downtown location or from a mobile lounge containing check-in facilities;

2. Centralized facilities - where all facilities including passenger handling, flight operations, equipment maintenance and hanger facilities would be provided in a single building. A downtown check-in terminal would be provided but passengers would be free to use either the downtown or airport terminal;

3. Decentralized facilities - where a separate structure would be provided for each main activity at the airport allowing each to be designed to meet the special purpose requirements associated with the activity which they are intended to serve. A downtown terminal facility would also be provided and passengers could select their check-in and departure point within the system (approximates the STOL Demonstration Project Layouts);

4. Integrated facilities - where each main activity would be housed in a separate structure to minimize construction costs. Components would be linked functionally and aesthetically in order to improve operating efficiency and the sharing of common use facilities. A downtown terminal would be provided, as for concepts 2 or 3.

The Toronto Island STOLport would require an additional facility on the mainland under options 2, 3, and 4, to accommodate passengers who would choose to park on the mainland adjacent to the ferry terminus. This facility would be a reception building, accomodating visitors, the non-travelling public, rent-a-car facilities and taxi pick-up, in order to reduce the demand on the ferry services.

2.4 TRAFFIC

Annual Traffic

The traffic estimates for the Toronto/Montreal/Ottawa system are based on an assumed 30 per cent penetration of the relevant mature CTOL market and penetrations into other modes. This CTOL market is currently depressed but is forecast to recover to its former level by 1985/1986. Thereafter modest annual growth (3 to 5 per cent) is likely.

The estimated market for STOL is based partly on demand factors and partly on supply side considerations. The major demand will be in the sector where at least one trip end lies within the CBD of each of the city pairs. On the supply side, annual STOL aircraft utilization is an important factor in system profitability, and ratios of peak to off-peak services must be carefully controlled to avoid under-utilization of aircraft. As a consequence, the selected schedule assumes some flattening

ing of the peak hourly flows relative to current CTOL experience. The latter system has greater flexibility to cope with peaks because of opportunities for substituting larger aircraft and combining services. This will not be possible in the STOL system.

The ability of the STOL system to respond to small increments of traffic growth is restricted. With 6 routes in the system, adding one additional aircraft to handle the incremental traffic growth on each route would mean that the fleet would have to grow incrementally from 8 aircraft to 11 aircraft if a balanced service was to be retained. Assuming no increase in the Ottawa/Montreal routes, the maximum increase would be from 8 aircraft to 10 aircraft. This would increase seat availability of the system by between 25 to 38 per cent which could represent a period of from 5 to 10 years of traffic growth

At current forecast growth rates,such increases in fleet size would not be profitable before the early to mid 1990's unless the initial market penetration factors are underestimated. For purposes of estimating system traffic demand the key assumption therefore made was that STOL traffic would be supply-constrained for approximately the first 8 to 10 years of its operation. Flexibility would, however, be provided in the plans to add a single operating ramp position at each airport to cope with possible traffic growth in the longer term.

Route	Person/Trips Annually		
	Weekdays	Week End	Total
Toronto/Ottawa			
Peak Months	146,308	22,140	168,448
Off Peak Months	42,602	7,920	50,522
Total	188,910	30,060	218,970
Montreal/Toronto			
Peak Months	218,510	32,800	251,310
Off Peak Months	63,903	11,880	75,783
Total	282,413	44,680	327,093
Montreal/Ottawa			
Peak Months	62,696	9,840	72,536
Off Peak Months	17,699	3,300	20,999
Total	80,395	13,140	93,535
Total System			
Peak Months	427,514	64,780	492,294
Off Peak Months	124,424	23,100	147,574
Total	551,988	87,880	639,868

Table 2 Forecast of Annual STOL Traffic Demand (Mature System)

Traffic forecasts have been prepared by City Center Airways covering two periods of the year. One period included the three least active months for business travel (July, August and December) and the second period included the remaining nine busy months. The forecast of annual traffic for the mature system is shown in Table 2.

Daily Traffic

The Canavia estimates of daily traffic are based on separate schedules developed for weekdays and for weekends. The total average number of weekday flights in the system is estimated at 72, and on weekends at 36 flights daily.

The scheduled daily one-way person trip on all routes combined were:

Weekdays	
Average 12 month period	2,125
Average 9 busy months	2,190
Average 3 off peak months	1,930
Weekends	
Average	845

The daily passenger estimates are as shown in Table 3.

Route	Flights Daily	Seats Daily	Load Factor*	Passengers Daily**
Toronto/Ottawa	24	1,200	.625	750
Montreal/Toronto	34	1,700	.659	1,120
Montreal/Ottawa	14	700	.459	320
Total	72	3,600	60.8	2,190

Table 3 Average Weekday One Way Person Trips (Mature Market)

* Average load factor for the nine busiest months.
** Average week day passengers, nine busiest months.

Peak Day Traffic

The peak day traffic will be constrained by aircraft availability. The busy period daily flows assume the following peak period load factors (PLF).

Route	Passengers
Toronto/Ottawa:	934 (1.21 x average)
Toronto/Montreal:	1,307 (1.14 x average)
Ottawa/Montreal:	413 (1.25 x average)
Peak Day Total System:	2,654

Route	Peak Period* Load Factor
Toronto/Ottawa	75%
Montreal/Toronto	80%
Montreal/Ottawa	55%

* Peak Period - Weekday - Morning 0630 - 0959 hours
Afternoon 1530 - 1900 hours

These load factors represent the average for two direction combined for each city pair. The STOL demonstration project determined that for the Ottawa/Montreal route 45 per cent of the passengers resided in Ottawa and 55 per cent in Montreal. Therefore, for the Montreal/Ottawa route, the 55 per cent average load factor for two directions translates into a 61 per cent load factor in the Montreal/Ottawa direction during the morning peak and in the Ottawa/Montreal direction during the evening peak. The average load factors in the reverse directions would be 50 per cent.

Assuming a similar imbalance on the Toronto/Ottawa route results in a peak period load factor of 82.5 per cent on the busier direction.

Assuming a balanced system, the maximum daily two directional traffic that could be generated on a route would result when the traffic in the busier direction reached 100 per cent. The maximum peak day traffic on the three routes, therefore, would not likely exceed the following levels:

Taking into account this value and the average weekday traffic flows for the 12 month, 9 busy months and 3 off-peak months a histogram was produced which approximately conforms to the following formula;

$$\text{Traffic (day N)} = 1905 + 0.55N + \left[\frac{N}{30.7}\right]^3$$

where N is the day of the required estiamte.

Since designing for the absolute peak day traffic would result in considerable overbuilding, the accepted practise is to design facilities on the basis of traffic levels between the average demand and the peak demand. The 90th percentile of traffic is one commonly used service standard. Substituting the 90th percentile week day (i.e. N = 234), in the equation results in a peak day traffic of originating 2,480 persons trips.

Passenger Origins:

The number of resident passengers originating in each city is a function of the relative populations of the cities in each pair. Estimated resident passengers origins for each route are shown in Table 4.

Route	Resident Passengers			
	Toronto	Montreal	Ottawa	Total
Toronto/Ottawa	232	--	190	422
Toronto/Montreal	310	286	--	596
Ottawa/Montreal	--	122	100	222
Totals	542	408	290	1,235

Table 4 Resident Passenger Origins on Planning Peak Day

The interzonal passenger movements between the three cities fall into three categories (Percentages based on STOL Demonstration Project):

Interzonal Interchange	% of Total Trips
CBD to CBD Zone	36
CBD to Outer Urban Zone	51
Outer Urban to Outer Urban Zone	13
TOTAL	100

The numbers of person trips involved in each interchange for the peak planning day are show in Table 5.

Interchange Route	CBD-CBD (36%)	CBD/Outer (51%)	Outer/Outer (13%)	Total
Toronto/Ottawa	304	431	110	845
Montreal/Toronto	429	608	155	1,192
Montreal/Ottawa	159	226	58	443
Total	892	1,265	323	2,480

Table 5 Planning Peak Day Interzonal Changes (Person Trips)

Flight Schedules

The proposed flight schedules for the mature system are shown in Tables 6 (week day) and 7 (week end).

The current intention is to offer a direct shuttle on each of the three routes. No connecting flights are envisaged. The service would commence with eight aircraft, with four overnighting at Toronto Island, three at Montreal STOLport and one at the Ottawa Rockcliffe STOLport.

2.5 Peak Period Schedule

The planned schedule shows three departing flights from each airport during each of the peak hours so that the total peak hour seat availability would be 150. The schedule also shows that two departures are often scheduled within fifteen minutes, resulting in a peak 1/2 hour seat availability of 100.

Schedules have not been developed for the 1990 traffic demand, but the forecasts of annual traffic indicate a likely 30 percent growth over the 1985 to 1990 period. This growth could be accommodated by increasing peak hour departures from 3 to 4 aircraft, which would result in a departure seat availability of 200. Since each airport serves only two routes introduction of a fourth aircraft during peaks implies a flight every half hour to one or other of the two destinations served from each airport; however, the half-hourly seat availability in 1990 would remain at 100.

The peak departure hours (the critical factor for facilities design) for the three airports are as follows:

Flight Origin	Flight Destination	
Toronto	Montreal 0700 hours 0800 hours	Ottawa 0820 hours
Montreal	Toronto 0700 hours 0800 hours	Ottawa 0715 hours
Ottawa	Toronto 0800 hours 0900 hours	Montreal 0810 hours

The seats available for departures at each airport during the peak hour would be 150. The peak hourly morning departure passenger flows for the peak planning day would be as follows:

Flight Origin	Flight Destination		Total Passengers
Toronto	Montreal 94	Ottawa 47	141

Departure	Arrival		Departure	Arrival		Departure	Arrival	
Toronto	Montreal	Ottawa	Montreal	Toronto	Ottawa	Ottawa	Toronto	Montreal
0645		0745						
0700	820		0700	0830		0700	0805	
0745		0845	0715		0750			
0800	0920		0800	0930		0800	0905	
0845		0945				0810		0840
0900	1020		0900	1030		0900	1005	
0945		1045	0915		0950			
1000	1120		1000	1130		1000	1105	
1100	1220		1100	1230		1010		1040
1145		1245	1200	1330				
1200	1320		1215		1250	1200	1305	
1300	1420		1300	1430				
1345		1445				1310		1340
1400	1520		1400	1530		1400	1505	
1500	1620		1500	1630				
1545		1645	1515		1550			
1600	1720		1600	1730		1600	1705	
1645		1745				1610		1640
1700	1820		1700	1830		1700	1805	
1745		1845	1715		1750	1800	1905	
1800	1920		1800	1930		1810		1840
1900		1945	1900	2030		1900	2005	
2000	2120		2000	2130		2010		2040
2045		2145	2100	2230				
2100	2220		2200	2330		2100	2205	
2200	2320	2345	2215		2250	2300	2005	
2245	2020		2300	0030		2310		2340
2300								

Table 6 Weekday Schedule (Mature Service)

Departure	Arrival		Departure	Arrival		Departure	Arrival	
Toronto	Montreal	Ottawa	Montreal	Toronto	Ottawa	Ottawa	Toronto	Montreal
0845		0945	0900	1030				
0900	1020		0915		950	900	1005	
1100	1220		1100	1230		1010		1040
1145		1245				1200	1305	
1300	1420		1300	1430				
1445		1545	1315		1350			
1500	1620		1500	1630		1500	1605	
1700	1820		1700	1830		1510		1540
1745		1845	1815		1850	1800	1905	
1900	2020		1900	2030				
2045		2145				2010		2040
2100	2220		2100	2230		2100	2205	
2245		2345	2215		2250			
2300	0020		2300	0030		2300	0005	

Table 7 Saturday and Sunday Schedule (Mature Service)

Montreal	Toronto	Ottawa	
	83	36	119
Ottawa	Montreal	Toronto	
	30	77	107

Examination of the proposed system schedule shows that the peak hour arriving flows would overlap with the departing flows. The 1986 schedule, however, allows a one-half hour turn-around time for the aircraft so that under a normal situation, the deplaning passengers will have cleared the airport before the enplaning passengers arrive. By 1990, there could be four departures during the peak hour and it would be reasonable to assume that two departures and one arrival could occur within a half-hour period. The half-hour flow rate therefore could be either 90 enplaning and 45 deplaning passengers, or 45 enplaning and 90 deplaning passengers.

In the case of the remaining three alternatives, the access system was assumed to be identical. Passengers would either originate and terminate their trips at the downtown terminal and use the STOLmobile to access the airport, or would park their cars at the airport and check-in at the terminal. In the case of the Toronto Island Airport, the situation is more complex because direct access to the island terminal by private vehicles is precluded. Passengers wishing to use the STOLmobile service would check-in at the downtown terminal as is the case for the Montreal and Ottawa systems. Persons wishing to drive to the airport would have to park their cars on the mainland. They would then have the option of either checking in at the landside terminal which would be provided, and join the STOLmobile, or they could walk directly onto the ferry and then walk to the island terminal.

The modal split between the STOLmobile and the private automobile was assumed to be 60 per cent in favour of the former based on the Air Transit experience. Peak hourly flows by STOLmobile in the zero base option would be 90 passengers (100 passenger requirement would be common) in 1986 and 135 passengers in 1990. Aircraft will frequently operate at full capacity and STOLmobile requirements may become either one 50 passenger vehicle for each flight, or two smaller vehicles. By 1990 the requirement would be for either three large vehicles or six smaller ones. In the case of the Toronto Island facility, the utilization of smaller buses would result in twelve cross-channel movements an hour, beyond the capability of the existing ferry service.

For the remaining three alternatives, the peak hourly departures could be handled by two buses per hour with an average passenger load of 37 people in 1986, and three similar buses in 1990. Given a free choice situation, considerable variation in modal split can be expected and a practical bus size would be of the order of 40 passengers for Montreal and Ottawa. The Toronto situation is more complex in that given a free choice situation, an undetermined number of departing passengers would proceed directly to the terminal building by ferry. The bus would have to be capable of carrying the passenger demand from the downtown terminal plus any passengers checking in at the mainland terminal. On the de-planing sequence, substantially all passengers would board the bus at the aircraft with some disembarking at the mainland terminal in order to return to their cars; to be met, to rent a car; or to take a taxi. Because of the short duration of the journey from aircraft to the landside terminal, these disembarking passengers might be transported as standing passengers on the bus.

3.0 AIR TRAFFIC CONTROL AND AIRFIELD ZONING

3.1 Air Traffic Control

The airside operating system for a STOL service assumes separate access on all routes utilizing area navigation (RNAV) en route coupled directly to a microwave landing system (MLS) for final approach and landing. The system envisages operations within a dedicated airspace.

Metropolitan STOLports will generally lie within the terminal area of the main hub airport serving the respective communities. Even at busy STOLports hourly movements should not exceed seven or eight arrivals and departures; and therefore, in most cases, air traffic control and other flight services could be provided from the air traffic control towers at the CTOL airport. Communications facilities would be provided for the filing of flight plans, for weather briefings, and for communicating with flight advisory services.

For purposes of the research study, it was assumed that the ATC services will be provided by Transport Canada through an on site control tower at major public STOLports and through UNICOM at privately operated STOLports.

3.2 Meteorological Facilities

En route weather information for STOL services would be obtained at each airport from existing services as is the case for CTOL services. At private STOLports a based operator would provide the local information on horizontal visibility, ceiling or vertical visibility, temperature, windspeed and direction, precipitation, and runway condition.To the extent possible, automatic sensing and transmitting equipment would be utilized to reduce operating costs. Weather information at Toronto Island would be available from Atmospheric Environmental Services.

3.3 En Route and Terminal Navaids

The area navigation (RNAV) system utilizing existing en route navaids is contemplated for the STOL service. The proposed system is similar to that demonstrated during the 1974-76 experiment, and will be further developed and tested by the carrier and Transport Canada.

Procedures for separate STOL access have been demonstrated jointly by de Havilland and the FAA at Washington International Airport. These procedures may also have application to the proposed Canadian service.

3.4 Electronic Landing Aids

Precision approach aids at all STOL airports would include a microwave landing system (MLS), consisting of two units, an altitude unit and an azimuth unit. Both ends of the runway would be instrumented.The equipment will be provided and installed in accordance with Transport

Canada standards. It is not expected that the zoning and clearance requirements of the MLS equipment will significantly constrain airport layout at any of the sites studied. A major advantages of the MLS system is that steep approaches are possible in order to clear obstructions generally present in the vicinity of urban airports. Curved approaches may also be permitted, allowing greater flexibility in avoiding conflicts with arrival and departure paths at adjacent airports within a common terminal area. Possible benefit of this feature were not examined in this study.

3.5 Visual Landing Aids

The principal visual landing aids will be approach and runway lighting. Pavement markings on the runways, taxiways and aprons will be in accordance with Transport Canada standards. No VASIS equipment is contemplated for STOL operations. Considerable potential savings over CTOL systems are possible as a result, particularly due to the reduced approach lighting requirement associated with the steeper glide slopes achievable with STOL aircraft.

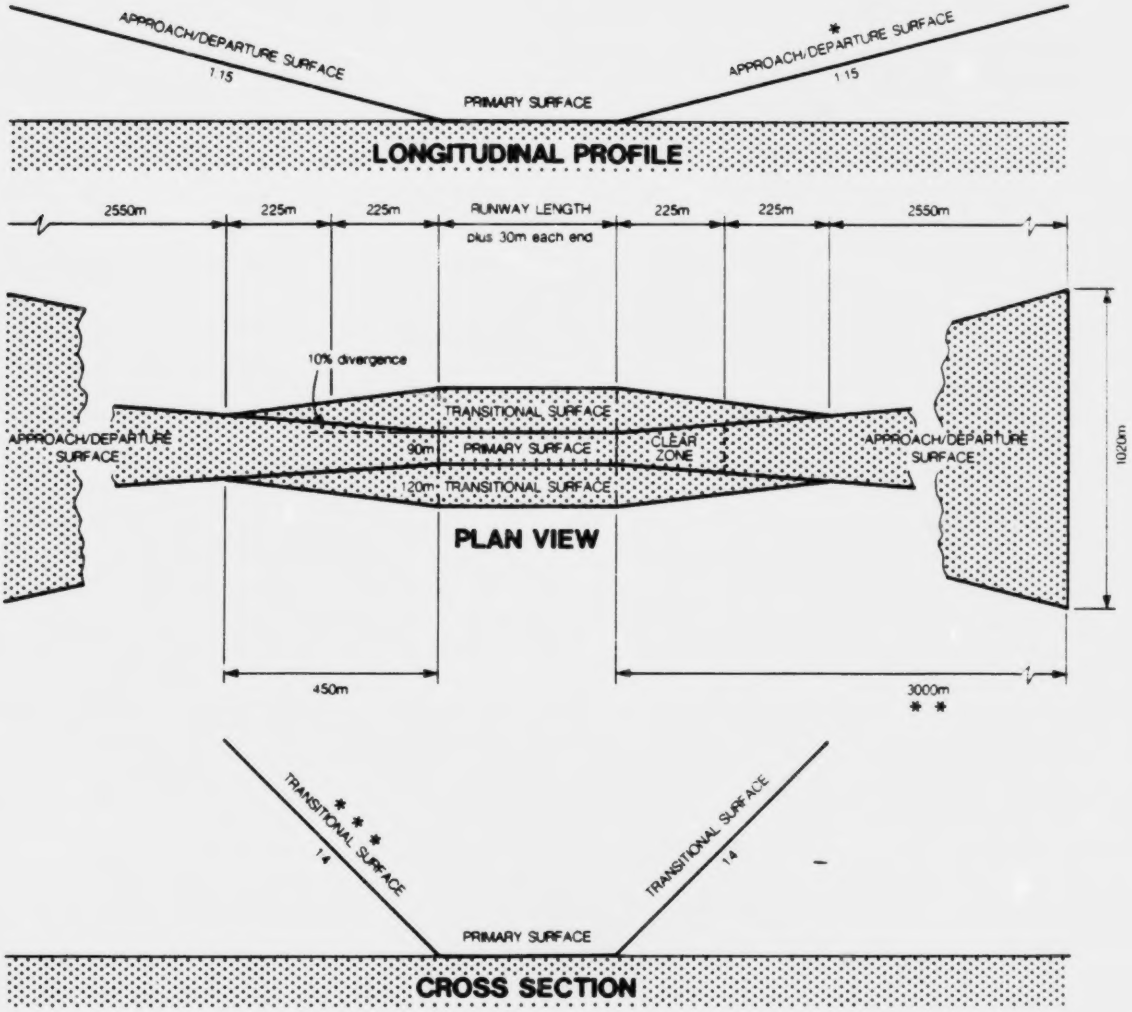
3.6 Airfield Zoning

The airfield zoning criteria which may most critically constrain airfield and groundside development are:

- The length and width of the Runway Primary Surface
- The slope of the Take-off and Approach Surfaces
- The Slope of the Transitional Surface

The protection surfaces diagram developed by the FAA for Metropolitan STOLports is shown on Figure 3. The Transport Canada draft standards have similar criteria with the following notable exceptions:

Take-off Surface:	The Transport Canada recommendation is for a length of 6,000 m compared with 3,000 m in the FAA standards. Transport Canada further recommends that the take-off and approach surfaces should clear the airport boundary by a vertical distance of at least 9 m. The take-off surface gradient shall be determined by using prescribed performance data for the design aircraft.
Outer Surface:	Where it is possible to conduct a circling procedure, on outer surface shall be established. The outer surface, measured


APPROACH/DEPARTURE SURFACE
1:15
*
APPROACH/DEPARTURE SURFACE
1:15
PRIMARY SURFACE
LONGITUDINAL PROFILE
2550m
225m
225m
RUNWAY LENGTH
plus 30m each end
225m
225m
2550m
10% divergence
TRANSITIONAL SURFACE
APPROACH/DEPARTURE SURFACE
90m
PRIMARY SURFACE
CLEAR ZONE
APPROACH/DEPARTURE SURFACE
1020m
120m
TRANSITIONAL SURFACE
PLAN VIEW
450m
3000m
* *
* * *
TRANSITIONAL SURFACE
1:4
TRANSITIONAL SURFACE
1:4
PRIMARY SURFACE
CROSS SECTION

VARIATIONS - DRAFT CANADIAN STANDARDS

*

SLOPE VARIES WITH DESIGN AIRCRAFT

* *

TAKE-OFF SURFACE LENGTH : 6000m

* * *

TRANSITIONAL SURFACE SLOPE : 1:5

figure 3

PROTECTION SURFACES

(FAA)

from the designated STOLport reference point shall extend to a horizontal distance of at least 3000 m.

A common plane shall be established at a constant elevation of 75 m above the assigned elevation of the STOLport reference point, or the elevation of the highest existing permanent structure within the area of the outer surface, whichever is higher, but in no case shall the elevation of the outer surface exceed 120 m. This requirement is not identified in the FAA standards.

Clear Zones: The FAA Standards identify clear zones 225 meters long immediately off each end of the primary surface. Transport Canada does not specify this requirement.

Transitional Surface: Slope

Slopes of the transitional surfaces shall normally be 20.0 percent (1:5). However, the Minister may authorize an increased slope up to a maximum of 50.0 percent (1:2) provided that certain specified conditions are met. The corresponding criteria is the FAA standards is a slope of 25 percent (1:4).

ICAO Suggested Practice

The following airfield zoning information is abstracted from the ICAO STOLport Manual - 9150 - AN/899

Runway Strip Length	30 m beyond the end of each runway.
Runway Strip Width	45 m laterally on each side of the underline of each runway.

Clearances:

A survey of the practices of ICAO member States indicates that the following minimum clearances are necessary for the safe operation of existing STOL aircraft:

runway centre line to taxiway centre line = 60 m

runway centre line to building line = 90 m

runway centre line to holding line = 30 m

runway centre line to edge of parked aircraft = 75 m

taxiway centre line to fixed obstacle = 30 m

Obstacle Limitations:

ICAO Standards do not qualify protection surface dimensions but state that "since STOL operations differ in some fundamental ways from CTOL operations, new zoning criteria are required to define the areas and slopes to be protected. The zoning criteria are required to define the areas ad slopes to be protected. The zoning criteria developed should accommodate both visual and instrument flights in the departure and approach phases of STOL operations."

Observations

Transport Canada Standards are the most flexible in that they allow consideration of specific aircraft performance in determining key criteria such as the approach and take off surface approach slopes. While the allowable slope of the transitional surface is less steep (1:5) than under the FAA recommendations (1:4), under certain conditions, this slope can be increased to 1:2 in Canada by the Minister.

4.0 AIRCRAFT MOVEMENT SYSTEM

4.1 Runway Requirements

All STOLports utilizing Dash 7 aircraft can operate with runways in a single direction. A crosswind runway is generally unnecessary because of the high demonstrated cross-wind landing capability of the Dash 7 aircraft (in excess of 20 knots under VFR conditions). A runway utilization factor of 97-98 percent is usually achievable within these limits at most airports and their level of availability is considered adequate for commuter services.

ICAO Requirements

Paragraph 1.2.2.6 of the ICAO STOLport Manual states "The minimum field length is determined from the longest distance required by take-off to 10.5 m (35 ft.) high, landing from 15 m (50 ft.) and accelerate stop activities. To meet these requirements adequately, a 600 m (2,000 ft.) runway with 120 m (440 ft.) clearway in length are also needed . . ."

The ICAO recommended take-off distance for the Dash 7 is 720 m (2,400 ft.); accelerate/stop distance, 675 m (2,250 ft.); landing distance, 600 m.

Federal Aviation Authority (U.S.)

FAA Advisory Circular 150/5300-8 recommends that take-off runway length requirements are to be established as follows:

Runway length at Sea Level and 90°F: 456 m to 547 m (1,500 ft. to 1,900 ft.) with corrections for elevation and temperature to be made on the basis of individual aircraft performance.

Transport Canada

The Transport Canada recommendations for runway requirements are as follows:

The STOLport runway length should be based on data obtained from the flight manual of the design aircraft (including the need to observe the weight, altitude and temperature relationship). Aircraft with flight manuals containing clearway data may take account of clearway. The length of the clearway must not exceed 300 m (1,000 ft.) but may extend across the airport boundary if the licensee can ensure that it will be kept clear of obstacles; stopways where provided, shall start at the end of the runway available for take-off.

Runway Length Requirements

The runway length requirements calculated in this Study for both take-off and landing operations are based on the de Havilland Aircraft of Canada Ltd. DASH 7 Flight Manual DSM-1-17A-1A - Section 4, Performance Data. This methodology reflects the requirements of FAR 25 (U.S.) and is Department of Transport (U.S.).

The terminology used is taken from the De Havilland manual, an abridged list shown in Figure 4.

The take-off path extends from the point at which the aircraft commences its take-off run to the point where it reaches an altitude of 456 m. The take-off distance is measured from the same start point to the point where the aircraft reaches a height of 10.6m above the runway surface. At or before this point the aircraft must reach its safe take-off speed (V2) assuming a single engine failure.

The permissible DASH 7 take-off weight at a given airport will be governed by the following factors:

Take-off Runway Available (TORA)
Take-off Distance Available (TODA)
Accelerate Stop Distance Available (ASDA)
The Intake Flap Setting
The Take-off Flap Setting
The Altitude of the Airport
The Ambient Air Temperature
Runway Slope and Surface Condition
Tail or Head Wind Component.

The allowable take-off weight for the DASH 7 (maximum allowable ramp weight 20,000 kg) was calculated in accordance with FAR 25, assuming the following (ISA = International Standard Atmosphere):

Airport Elevation	-	0 and 304 m
Wind	-	0
Temperature	-	ISA + 10°C
Screen Height	-	35 ft (10.6 m)
Take-off Flap Setting	-	Retracted
Runway Slope	-	0%
Runway Conditions	-	Hard and Dry

The take-off runway requirements for the balanced runway concept are shown in Table 8 and for the unbalanced runway concept in Table 9.

Take-off Runway Requirements

The runways required for a range of aircraft weights and airport conditions have been calculated under two concepts:

(a) Balanced Field Length - where the take-off distance equals or exceeds the accelerate/stop distance

(b) Unbalanced Field Length - where the take-off distance includes a clearway.

V1 - (Critical engine failure recognition speed) - Speed at which, due to engine failure or other causes, the pilot may elect either to stop the aircraft or to continue take-off.

VR - (Rotation Speed) - Speed at which aircraft rotation is initiated during take-off to attain the required V2 climb speed at or before a height of 10.6m above the take-off surface.

V2 - (Take-Off Safety Speed) - The climb speed to be attained at or before a height of 10.6m above the take-off surface during a continued take-off following an engine failure.

V35 - Take-off speed to be attained at or before a height of 10.6m feet above the take-off surface during a continued take-off with all engines operating normally.

TOD (Take-Off Distance) - The take-off distance is the longer of the following:

a. The distance from the start of the take-off roll to the point where the aircraft attains a height of 10.6m above the take-off surface, with critical engine failure at V.

b. 115 percent of the distance from the start of take-off roll to the point at which the aircraft attains a height of 10.6m above the take-off surface with all engines operating normally.

ASD (Accelerate Stop Distance) - The accelerate stop distance is the sum of the following:

a. The distance required to accelerate the aircraft from a standing start to the speed V1.

b. Assuming a critical engine failure at V1, the distance required to bring the engine to a full stop from the point at which V_1 (speed is attained).

Balanced Field Length - This holds when the take-off distance equals or exceeds the accelerate stop distance.

Take-Off Run - Refers to the case where the take-off distance available (TODA) includes a clearway (unbalanced field length). The take-off run is the longer of the following:

a. The distance from the start of take-off roll to the mid point between lift off and the point at which the aircraft attains a height of 10.6m above the take-off surface, with critical engine failure at V1.

b. 115 percent of the distance from the start of take-off roll to the mid point between lift off and the point at which the aircraft attains a height of 10.6m above the take-off surface, with all engines operating normally.

Clearway - The area beyond the edge of the take-off surface, being a width of or 152m minimum, centred on the extended centreline of the take-off runway under the control of the airport authority. The clearway plane extends from the end of the runway at an upward slope not exceeding 2.5%, above which no object or terrain protrudes[2].

figure 4

RUNWAY DESIGN TECHNOLOGY

Take-Off Runway Available (TORA)		Accelerate//Stop Distance Available (ASDA)		Maximum Allowable Take-Off Weight 000's (lbs & Kg)					
				ISA, Sea Level		ISA + 10°C			
						Sea Level		304 m	
ft	m	ft	m	lb	Kg	lb	Kg	Lb	Kg
1,800	547	1800	547	38	17	36	16	34	15
2,000	608	2,000	608	40	18	38	17	36	16
2,200	669	2,200	669	42	19	40	18	38	17
2,400	744	2,400	744	44	20	42	19	40	18
2,600	805	2,600	805	-		44	20	42	19

Table 8 Maximum Allowable Take-Off Weights Balanced Runway Concept

Take-Off Runway Available (TORA)		Maximum Usable Clearway		Take-Off Distance Available (TODA)		Accelerate Stop Distance Available (ASDA)		Reference Distance		Maximum Allowable Take-Off Weight		
										ISA, Sea Level	ISA + 10°C	
											Sea Level	304 m
ft	m	ft	m	ft	m	ft	m	ft	m	kg	kg	kg
1,800	547	200	60	2,000	608	1,800	547	2,000	608	18,409	17,000	16,000
2,000	608	250	76	2,250	684	2,000	608	2,225	676	19,318	18,000	17,000
2,200	669	250	76	2,450	744	2,200	669	2,400	729	20,000	19,000	18,000
2,400	744	300	91	2,700	820	2,400	744	2,650	805	-	20,000	19,000
2600	805	300	91	2,900	881	2,600	805	2,825	858	-	-	20,000

Table 9 Maximum Allowable Take-Off Weights Unbalanced Runway Concept

Landing Runway Requirements

The landing runway requirements are a function of the approach speed of the aircraft and the wing flap settings. The maximum allowable landing weight of the DASH 7 is 19,090 kg. Variation of landing speed with flap settings and aircraft weight for the DASH 7 is as follows:

	Equivalent Air Speed (Knots)	
Landing weight:	15,909 kg	19,090 kg
Flap Setting 25°	82	91
Flap Setting 45° (Standard)	74	82
Flap Setting 45° (Special STOL)	74	82

The operating conditions assumed for landing distance determinations were as follows:

Engines - All operating or with one engine out.
Screen height - 15.2 m (Standard 10.6 m)(FAA Special STOL).
Wing flaps - 45° (Standard and FAA Special STOL).
Approach speed - (19,090 kg aircraft) - 82 Kt.
Runway condition - Hard and dry.
Runway field length factor - 0.6
Retardation - Maximum main wheel anti-skid braking, ground and roll spoilers extended, 3 propellors at DISC.
Wind conditions - Still air, 5 Kt to 10 Kt tail winds.
Airport altitude(s) - Sea Level and 304 m.

The runway length required for the range of conditions is shown in the following table.

Tail Wind (Knots)	Standard 45° Flap		FAA Special STOL 45° Flap	
	Sea Level	304 m ASL	Sea Level	304 m ASL
0	638	653	577	608
5	714	729	638	668
10	851	866	729	851

Table 10 Landing Runway Length Requirements [F+(M)]

Braking energy absorption is not critically limiting and a minimum aircraft turn around time of 5 minutes is achievable.

Net Take-Off Flight Path

The take-off flight path extends from the point at which the aircraft starts its take-off roll to the point where it reaches an altitude of 456 m above the take-off surface, or at which transition from the take-off to en route configuration is completed whichever is the higher (FAR 25.111).

The net take-off flight path commences at the take-off point, which is the point where the aircraft reaches a height of 10.6 m above the take-off surface.

The net take-off flight path consists of four segments as follows:

Segment 1 - Take-off to retraction of landing gear.
Segment 2 - Level to 121 m
Segment 3 - Acceleration at 121 m to en route climb speed.
Segment 4 - Climb to 456 m.

The net take-off flight path requirements should be based on the following assumptions:

Flaps - 25° at take-off.
Power - one engine inoperative.
Speed - Segment 1 - 2 = V_2, thereafter en route climb speed.
Landing Gear - Segment 1: extended.
Segments 2,3,4: retracted.
Intake Deflectors - Retracted.
Airport Guidelines - Elevation - Sea level
Wind conditions - 0
Aircraft Weight - Example 1; 18,636 kg.
Example 2; 20,000 kg.

The horizontal distance travelled by the aircraft and the altitude attained on each segment is shown in the following table.

Segment	Aircraft Weight 18,636 kg			Aircraft weight 20,000 kg		
Number	Reference Climb Gradient	Altitude (m)	Horizontal Distance (m)*	Reference Climb Gradient	Altitude (m)	Horizontal Distance (m)*
Takeoff	-	0-10	729	-	0 -10	820
1.	0.06	10-30	504	0.05	10 -25	510
2.	0.06	30-121	1,520	0.05	25 -121	1,854
3.	0	121	2,280	0	121	2,584
4.	0.55	121-456	6,080	0.04	121-456	6,840
Total*			8,074			9,873

Table 11 Aircraft Net Take-off Flight Path Coordinates.

* Totals may not add due to metric conversion and rounding.

4.2 Taxiway Requirement

The runway acceptance rate under Instrument Flight Rules (IFR) conditions assuming light aircraft arrivals only and a one-to-one arrivals/departures ratio, is approximately 36 movements an hour without a parallel taxiway and 50 movements an hour with a full parallel taxiway.

The intended precision approach runway at Toronto Island is already equipped with a full parallel taxiway, and given that the precision landing aid will be an MLS system, and given that it is unlikely that many of the light aircraft using the airport will be equipped with the necessary avionics package, it is highly unlikely that the IFR capacity of the airport will be exceeded.

In the case of the Montreal STOLport, its use will be restricted to private carrier operations. There appears to be adequate flexibility in the schedule for that airport to ensure that all movements can be accommodated without significant delay and without a parallel taxiway. However, there was only a single west end taxiway connection between the runway and the apron, and as a result during the STOL demonstration project, some congestion was experienced. A second connection at the east end of the apron would greatly facilitate taxiing operations, and should be planned for.

The intended precision approach runway at the Rockcliffe airport does not have a parallel taxiway. The peak loading on this runway will occur during VFR conditions when flying club activities and STOL operations take place simultaneously. The current plans for this airport envisage that both the STOL and general aviation aircraft parking will be located at the eastern end of the runway with little scope for segregating the two operations. Operating procedures will have to be developed to give priority to the IFR operations of the STOL carrier. While this will result in delays to the flying club operations, it is doubtful that the resulting economic disbenefit would justify construction of a parallel taxiway, at least not in the short term. A compensating factor is that most of the flying club activities take place on weekends when STOL movements on average would probably not exceed two or three per hour.

4.3 Aprons

The apron dimensions for a single Dash 7 as determined by the manufacturer (45° Nose-in forward power docking procedures) are 58 m (along the terminal face) by 33 m. These dimensions assume a 7.6 m building clearance and the same clearance between manoeuvering aircraft. Discussions with the carrier indicated that for a single carrier operations, these clearances might be reduced to one metre between the aircraft and the building and to 2 metres between a moving aircraft and a parked aircraft. The effect of these relaxations would be to reduce apron dimensions to 53.4 m (along the building face) by 27.4 m. Net apron parking area per aircraft would be reduced by approximately 25% from 1,914 square metres to 1,463 square metres.

5.0 PASSENGER HANDLING FACILITIES

5.1 Background

At conventional airports, all passenger processing is usually carried out on site; at metropolitan STOLports, which can be located adjacent to central business districts, passenger processing facilities may be located partially or entirely in the central business district, or be replaced altogether by providing transport vehicles equipped with passenger and baggage check-in facilities.

Airport passenger terminals are conventionally the main passenger connection point with road vehicles transporting passengers. They must accommodate a number of inter-related activities common to both CTOL and STOL operations such as:

- passenger check-in and baggage drop
- departure lounge
- public waiting
- deplaning passenger baggage claim
- delayed or standby passenger waiting
- ground transportation interface.

The design and size of the terminal is determined on the basis of a number of passenger and air carrier related factors such as:

- peak period passenger and visitor accumulations
- passenger attributes
- passenger processing requirements
- space and service levels standards
- the number of carriers to be accommodated
- impacts of delays and unscheduled outages.

The major difference in the design of CTOL and STOL facilities is the relatively small size of STOL aircraft. This limits the magnitude of passenger surges and can also simplify or eliminate security requirements for boarding. This latter factor is a particularly important consideration in the planning of flight specific ground passenger transfer systems.

A glossary of passenger terminal planning terminology is provided as an Appendix.

5.2 Passenger Attributes

The characteristics and preferences of STOL passengers are expected to remain similar to those exhibited during the 1974-76 Transport Canada STOL demonstration. The majority of passengers will be travelling for business purposes (approximately 92 percent) and approximately one half will originate in or be destined to a central business district. Forty-four percent of all trips are expected to originate at the commuter's workplace, and thirty-five percent were returning to their workplace.

Forty-four percent of all resident departing passengers chose to travel to the airport by automobile. Thirty-six percent chose the STOLmobile; however, a reverse trend was exhibited for arriving passengers, with 48 percent choosing the STOLmobile and 41 percent the private automobile.

Other relevant passenger attributes information is available from C.A.S.E. studies conducted for Transport Canada at various airports. Of particular interest are the attributes of domestic short haul passengers:

- At Lester Pearson International Airport (PIA) in Toronto, enplaning passengers spend approximately 62 minutes in the terminal building, including processing and waiting time; at small airports, average dwell times are of the order of 34 minutes. Deplaning passengers spend 42 minutes in the terminal on average at PIA and between 8 to 15 minutes at small airports;

- 0.4 pieces of baggage are checked per passenger;

- There are 0.2 well-wishing visitors (wellwishers) and 0.5 greeting visitors (greeters) per departing and arriving passenger respectively.

The 34 minute dwell time observed for enplaning passengers at small airports would apply primarily to passengers arriving by private car and taxi. STOLmobile passengers would have significantly shorter terminal dwell times since vehicle arrivals could be timed more closely to aircraft departure time. The suggested standard dwell time for passengers arriving by STOLmobile is 15 minutes and for all deplaning passengers, 10 minutes.

5.3 Planning Standards

Canadian planning standards, developed specifically for STOLport passenger terminals have not been published in final form but various documents are available for planning small or northern conventional airport terminals. These have some application. ICAO STOLport standards do not include detailed terminal standards, and the FAA provides only general guidelines which primarily relate to general use areas such as public and circulation areas. Stairwells, washrooms, or auxiliary corridors requirement are not generally addressed, necessitating reference to sources such as national and local building codes.

Applicable planning standards consulted during this study are listed in Appendix B.

5.4 Planning Considerations

Principal design considerations for private STOLport passenger terminal facilities are simplicity, flexibility, adequate separation between functional areas and low capital and operating costs. These attributes if properly addressed can also promote functional organization and aesthetic appeal. Areas of significant difference between the planning requirements with respect to these criteria for CTOL and STOL are addressed in this section.

Ground Access

Except for the zero facilities option, which would not require automobile access to the airport, the STOLport systems considered are to be capable of accommodating private automobiles, taxis and STOLmobiles. The concepts assumed direct pedestrian access from terminal parking, rental returns, curbside drop-off/pick-up and employee parking. The major variable between CTOL and STOL is that the latter system has a relatively low parking requirement because of its proximity to the central business district, usually well served by public transportation.

The Toronto Island STOLport must be reached by a marine ferry. The access system at this site therefore assumes that passenger and employee parking would be provided adjacent to a reception building which would be located at the mainland ferry terminus.

It was assumed that the downtown terminals for all three cities would be located at sites having adequate public and private parking at commercial rates.

Access to Aircraft

Aircraft manoeuvering areas and apron parking adjacent to the terminal can be provided as either a linear or pier terminal configuration depending upon the number of aircraft to be parked at peak periods. If the number of parked aircraft does not exceed six, the linear parking system is generally the more suitable, since it is usually cheaper to build and permits access to the aircraft from a central location without excessive walking distances. In other situations, when aircraft are large or more numerous, or site configuration dictates, a pier system consisting of a canopied or enclosed corridor may be the preferrable solution. The maximum aircraft parking requirement for the airports researched during the study was four, therefore only a linear terminal configuration was considered. Loading bridges are not believed to be justifiable at STOLports.

Building Layout

Because of the low passenger volumes and terminal dwell times involved, a single level terminal building only was considered. The selected arrangement assumed segregated inbound and outbound passenger and baggage flows.

Departures Lobby

This functional area should be located as to permit direct access, by passengers carrying luggage,, to the check-in counter. The recommended distance between the entrance curb and check-in counter should not exceed 20 m for the convenience of passengers carrying luggage. Airline ticket counters may be configured as islands for rapid flow-through or located in line for greater corporate identity and physical separation. A special consideration is the relatively large surge in enplaning passenger, flows which result from flight specific STOLmobile operations.

Public circulation and seating, access to gates, concessions and washrooms should be organized in close proximity, but without interrupting direct passenger access between the functional areas. Non-smoking areas are to be provided for public areas with 30 or more seats, with 50 percent of those seats being designated for non-smokers. The requirements for visitor waiting space are minimal at STOLports, partly because of the low well wisher ratios associated with the short business trips for which the service is intended and partly because visitors would not be carried on the STOLmobiles.

Passenger Security Inspection

Security screening is not considered mandatory for domestic services using the small aircraft assumed in the study. However, should passenger screening be required in future, a single station consisting of one or two inspectors with detection wands, a electronic metal-detection arch, and baggage x-ray unit, could be positioned in the departures lobby at entrance to a "sterile" holdroom. (Space requirements for inspection tables and equipment and flow through access are in the order of 10 square metres - FAA).

Departures Holdroom

A separate "sterile" waiting area, located at the apron face of the terminal near the departures gates is required and should include public circulation space, public seating with non-smoking area and room for standees. Access to the aircraft would be on foot under a protective canopy. No fixed loading bridges are believed necessary. Passenger transfer by STOLmobile or mobile terminal between the terminal and the aircraft are possible options. Because of the short passenger dwell times associated with STOLmobile operations reduced space standards may be considered.

Concessions

Because of short terminal dwell times by passengers, particularly those using a STOLmobile service, and because of the low well wishers/greeter ratios associated with business travelling the market potential for staffed concessions other than car rentals is considered to be low.

Deplaning Area

This functional area should be large enough to accommodate peak surges in deplaning passengers which because of short dwell times should not exceed the capacity of one aircraft. Direct delivery of baggage to the departures curb deserves careful consideration of the capacity of one aircraft. More specific details on baggage handling concepts and requirements are detailed in Section 5.7.

5.5 Enplaning System Alternatives

The enplaning passenger process within an airport terminal building involves the effective channelling and control of passengers from the arrivals curb to the departing aircraft. Conventional processing activities are normally segregated and categorized into separate functional areas as follows:

- departures curb
- departures lobby
- ticket check and baggage drop
- security screening (not considered nessary for the systems studied)
- departures lounge
- standby counter
- aircraft boarding control
- explaining baggage transfer.

Three enplaning system concepts were considered:

1. Centralized Check-In, assumes a conventional approach in which passengers arrive at the terminal curb by private automobile, taxi or STOLmobile and proceed to a check-in counter for boarding passes and to drop off baggage. They may then wait in the main lobby or proceed directly through a security inspection station (if required) to the holdroom to await aircraft boarding. Passengers transferring from remote or downtown terminals by STOLmobile are also obliged to proceed through the terminal in the same manner. Boarding passengers depart through the appropriate terminal gate and walk to the aircraft or are transferred by apron vehicles to remote aircraft. Baggage is tagged and sorted near the check-in positions and then transferred directly to the aircraft in carts.

2. Split Check-in assumes a conventional system incorporating a split at-gate processing sub-system which allows passengers a choice of check-in options, depending upon whether or not luggage is to be checked. Passengers without baggage or arriving from a downtown terminal by STOLmobile may proceed to the gate check-in counter for direct entry to the holdroom. Passengers with baggage are handled in the conventional manner.

This type of processing provides a higher level of service for passengers without baggage (assumed to be approximately 60 percent of the total) and for passengers already checked in at a downtown terminal. It also requires less space for public waiting and queuing areas.

3. A Zero Facilities Option assumes the processing of passengers off the airport aboard a special vehicle which also transfers them from a downtown pick-up directly into the aircraft cabin. The mobile terminal features use of a weather resident ramp or linkages to the aircraft's airstairs, thereby bypassing terminal facilities entirely. Baggage check-in and claim facilities are available on the vehicle.

On-airport passenger facilities requirements are limited to a small waiting room to accommodate passengers during major delays or interruptions in the air service.

5.6 Deplaning System Alternatives

Deplaning systems for both conventional and split enplaning terminals alternatives are similar. Conventionally deplaning passengers leave the aircraft and proceed through the arrivals corridor to the baggage claim area, retrieve their luggage and cross the arrivals lounge to the curb. For STOLports with high levels of STOLmobile usage consideration should be given to providing a mobile passenger pick-up baggage rack parked along the terminal curb or for direct transfer of baggage from the aircraft to the STOLmobile. This latter option requires that STOLmobile baggage be identified at time of check in.

For the zero facilities option, the direct transfer of passengers and baggage to waiting STOLmobile or mobile terminal from the aircraft would be mandatory. Baggage could be claimed directly from transfer vehicles (with STOLmobiles only) or at a downtown terminal. Either deplaning option is possible for the operations under consideration. The mobile terminal option is preferred for the Toronto Island STOLport since it can provide a higher level of service by eliminating the need for a landside terminal and the resulting additional passenger interchange at the ferry terminus.

5.7 Baggage Handling System Alternatives

At conventional airport terminals, baggage is checked in and tagged at the airlines ticket counter and then placed on a conveyor belt or roller for further sorting and consolidation in the baggage make up area. There it is loaded onto apron vehicles for reloading into the aircraft. Deplaned baggage is loaded on vehicles on the apron and transferred to the terminal where it is placed on in-bound conveyors leading to "race track" or carousel type display and retrieval units.

At STOLports accommodating shuttle air services by a single carrier, there is no requirement for either the sorting of enplaning baggage or for interlining services. This permits the utilization of simple manual baggage systems on the enplaning sequence; a minimum solution might be to load enplaning baggage directly on to apron vehicle for transfer to the aircraft.

Since only 0.4 bags per commuter passenger are envisaged for the STOL service, a simple baggage rack or roller track conveyor accommodating approximately 25 bags would be adequate in the deplaning area. Alternately, the baggage carts used for apron transfer could be brought into the claim area or parked on the terminal curb.

Suggested variations to these basic handling systems may involve less handling and shorter transfer times. One concept assumes special purpose battery powered vehicles which would incorporate baggage display racks. During check-in the vehicle would be located adjacent to the check-in counter and bags would be loaded directly by the check-in attendant. For aircraft loading the vehicle would be self-propelled across the apron and at the aircraft, the rack would be elevated to the correct position for loading. For deplaning the operating cycle would be reversed except that the baggage on the vehicle would be delivered to the corridor in the arrivals concourse. Arriving passengers would pick up their bags directly from the display rack incorporated into vehicle.

Small baggage carts could be used and handled manually within the building and towed in trains by tractors or manually across the apron. Use of a STOLmobile will necessitate baggage handling at both the remote terminal and at the airport terminal. At the former terminal, enplaning passengers would check their baggage at the check-in counter and airline personnel would load it into the STOLmobile; at the airport the operator would either place the baggage on a transfer vehicle or load the aircraft directly.

Deplaning passengers would retrieve their luggage at the air terminal claim area, or have airline personnel load it into the STOLmobile.

Alternatively, the STOLmobile could be loaded at the aircraft.

The mobile terminal would eliminate the need for baggage facilities at either the airport or the CBD since all baggage handling facilities could be provided on the vehicle.

5.8 Concessions

Commercial services identified by Transport Canada's Standard Terminal Expansion Program (STEP) for small airports, may include the vending of:

- food and beverage
- smoking materials
- newspapers
- gifts and souvenirs
- locker space
- automobile rentals
- telephones and
- postal services

The demand for concessions at domestic airports accommodating short haul flights is less on a per capita passenger basis than at airports accommodating long haul flights. In the former case a large proportion of the passengers are business travellers, usually unaccompanied by non-travellers who do not voluntarily spend much time at the terminal. The use of STOLmobiles further shortens terminal dwell time. Consequently, the demand for attendant-operated concessions is judged to be low. Basic needs could be largely accommodated by providing coin operated vending machines, however, special amenity facilities might be justified as a means of encouraging traffic.

5.9 Parcel Service

There is scope for implementing air mail, and small parcel courier services. All are compatible with the carrier's daily schedule and rapid turn around time. Limited drop-off facilities such as counter space and mail slot/bag could be provided near each check-in area. Larger scale operations involving locked storage rooms and cargo handling equipment are also possible but were not examined in this study.

5.10 Level of Service

Passenger terminals, in common with other public facilities such as utilities, communication systems, roads and other transportation systems are sized on the basis of peak period demands. For passenger terminals, the key factor is the peak passenger accumulation in each functional area of the building. Generally, it is impratical to size facilities to accommodate the absolute peak, since this would result in significant overprovision during off peak periods.

A common procedure is to select a design peak hour having a passenger flow below that in the absolute peak hour, and then to select a compatible space standard to give the desired service level. Service levels are allowed to deteriorate during periods when the peak passenger accumulation exceeds that of the planning peak period but such overloads usually occur infrequently and persist only for short periods.

Service levels take into account not only the per capita space required to satisfactorily accommodate the various activities, but also the length of time the peak demands are likely to last.

A number of service level standards have been developed by various airport authorities and airline organizations. Typical of these are the level of service standards developed by Transport Canada as part of the CASE Program for Passenger Terminal Evaluation.

This methodology assumes five levels of service defined as follows:

A. excellent level of service, condition of free-flow; no delay; direct routes, excellent level of comfort;

B. high level of service, condition of stable flow, high level of comfort;

C. good level of service, condition of stable flow, provides acceptable throughput, related sub-systems in balance;

D. adequate level of service, condition of unstable flow, delays for passengers, condition acceptable for short periods of time;

E. unacceptable level of service, condition of unstable flow, sub-systems not in balance, represents limited capacity of the system.

F. system breakdown, unacceptable level of congestion and delays.

Typical congestion standards recommended by Transport Canada are shown on Table 12.

Subsystem	Level of Service Ranges (Square Metres Per Occupant)					
	A	B	C	D	E*	F
Check-In	1.6	1.4	1.2	1.0	0.8	Subsystem Breakdown
Wait/Circulate	2.7	2.3	1.9	1.5	1.0	
Hold Room	1.4	1.2	1.0	0.8	0.6	
Bag Claim Area (Without Device)	1.6	1.4	1.2	1.0	0.8	

Table 12 Congestion Standards

* For periods up to 15 minutes within the 90th percentile peak planning hour.

The service standard recommended by Transport Canada for conventional terminals is level C.

The acceptable level of service is highly sensitive to the length of time a peaking condition is likely to exist. The use of STOLmobiles greatly facilitates control of passenger peaking which results from aircraft delays. Passengers can either be held downtown or in the STOLmobile for short periods to avoid congestion at the airport terminal building. The latter is particularly true if the passengers on the vehicle have already been processed at the downtown terminal and require no further processing prior to boarding the aircraft.

It is therefore recommended that level of service "D" be considered for those concepts envisaging STOLmobile services combined with CBD processing.

5.11 Passenger Terminal Space Requirements

Space requirements were calculated for each of four operating assumptions based on a peak 1/2 hour flow of 100 passengers, and peak hour flow of 150 passengers (normal peak accumulation in terminal 100 enplaning passengers. The peak deplaning accumulation would be 50 passengers the full capacity of a Dash 7 aircraft. Four airport access alternates were considered:

- conventional access
- STOLmobile access to terminal
- STOLmobile access to aircraft
- mobile terminals

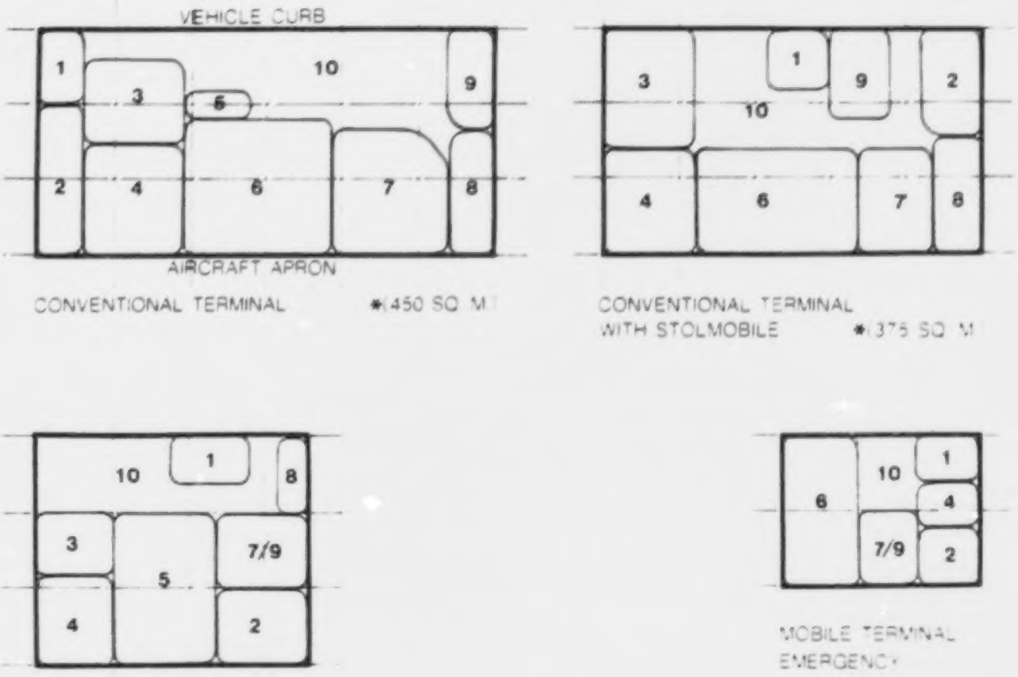
Estimates of space requirements are shown on Table 13. Typical building layouts are shown in Figure 5.

Conventional

This concept is found at most airports. It assumes that 100 percent of all enplaning passengers will check in at the airport (including those

FACILITY		CONVENTIONAL TERMINAL				CONVENTIONAL TERMINAL WITH STOLMOBILE				SPLIT CHECK-IN TERMINAL WITH STOLMOBILE				ZERO FACILITIES OPTION			
		PASS.	M^2/OCC.	ACCUM.	*TOTAL	PASS.	M^2/OCC.	ACCUM.	*TOTAL	PASS.	M^2/OCC.	ACCUM.	*TOTAL	PASS.	M^2/OCC.	ACCUM.	*TOTAL
TICKETING		100	1.2	0.3	36	100	1.2	0.4	48	40	1.2	0.3	15	-	-	-	-
WAITING	Enplaning	100	1.9	0.15	29	40	1.9	0.15	11	40	1.9	0.15	11	-	-	-	-
	Deplaning	50	1.9	0.35	33	20	1.9	0.35	13	20	1.9	0.35	13	-	-	-	-
HOLD ROOM		100	1.0	0.9	90	100	0.8	0.9	72	100	0.8	0.9	72	50	1.0	1.0	50
BAGGAGE CLAIM		50	1.2	0.4	24	50	1.2	0.4	24	20	1.2	0.4	10	-	-	-	-
WASHROOMS					16				16				16				12
CONCESSIONS					24				24				24				10
FOOD SERVICES					54				38				22				-
SECURITY					10				-				-				-
SERVICES					30				30				30				15
AIRLINES					40				40				30				15
SUB TOTAL					386				316				243				102
CIRCULATION & GROSS UP				(15%)	58			(15%)	47			(20%)	49			(20%)	21
TOTAL					444				363				292				123

Table 13 Passenger Terminal Building Requirements


VEHICLE CURB
AIRCRAFT APRON
1
2
3
4
5
6
7
8
9
10
7/9

CONVENTIONAL TERMINAL *(450 SQ M)

CONVENTIONAL TERMINAL WITH STOLMOBILE *(375 SQ M)

STOLMOBILE TERMINAL *(275 SQ M)

MOBILE TERMINAL EMERGENCY BUILDING *(130 SQ M)

LEGEND

1 Washrooms
2 Services
3 Check-in
4 Airlines
5 Security
6 Hold Room
7 Food Service
8 Bag Claim
9 Concessions
10 Waiting/Circulation

Scale 5 m x 5 m Grid

* AREAS ROUNDED

figure 5

ALTERNATIVE PASSENGER TERMINAL LAYOUTS

arriving by STOLmobiles and that all deplaning passengers will pick up their baggage in the deplaning area of the terminal. A complete range of terminal building facilities would be required on the basis of peak hour demands. Such facilities will include these functional areas:

- enplaning/deplaning curb access
- check-in counters
- baggage check-in
- public waiting area
- security station
- departure lounge
- concessions and public amenities
- arrivals area
- baggage claim and
- infrastructure - airline ticket counter support.

Airline management and operating space including crew rooms and utilities were assumed to be located in airport administration building. Total building area required is in the order 631 square metres (assuming hypothetically 100 peak hour deplaning passengers under the no delay conditions).

STOLmobile Access to Terminal

This system envisages the transfer to the airport terminal of approximately 60 percent of all passengers by STOLmobile from a remote terminal in the central business district to the STOLport. Because two aircraft departures could occur within a 15 minute period, and because 15 minute aircraft departure delays are common, no reduction in peaking due to STOLmobile operations was assumed. Passenger check-in would be of the split type with STOLmobile passengers proceeding directly to the departure lounge of the on-airport terminal.

Both the airport terminal building and downtown terminal would have passenger and baggage facilities but at a reduced scale at the airport since 60 percent of the passengers will have checked their baggage at the downtown terminal. These passengers would not be accompanied by non-travelling friends thereby further reducing the demand for waiting room space.

Space requirements at the central business district terminal would be 138 square metres, but could be considerably reduced if the check-in facilities could be located in a hotel lobby or in existing bus or train depots where lobby space sharing was possible.

Space requirements at the Toronto Island STOLport could be reduced by providing check-in facilities on the mainland adjacent to the ferry dock.

STOLmobile Access to Aircraft

This system assumes that 60 percent of the passengers would be processed at the CBD location and 40 percent at the STOLport terminal. Passengers processed downtown would be shuttled directly to the aircraft, bypassing the STOLport terminal. This concept is particularly beneficial to the passenger because it provides a direct, hassle-free link to the aircraft and is beneficial to the carrier because it reduces the space required for public seating and amenities at the STOLport. Also, under severe delay conditions, passengers could be held at downtown locations to the benefit of both the traveller and the airline.

Mobile Terminals

Since under this concept all passenger and baggage processing would be with the mobile terminal only a small facility would be required at the airport to permit off-loading of the mobile terminal under severe delay or emergency conditions. Potential benefits of the system are:

- reduced or minimal fixed terminal space requirements anywhere in the System
- greater control over passenger flows to match aircraft on time performance.

5.12 Passenger Terminals - Impact of Delays

A comparison was made of terminal space requirements at the CBD and landside sites in Toronto during "normal" and delay conditions. Normal conditions were assumed to include delays of up to 15 minutes duration while serious delays could entail service stoppages of one or more hours. (One hour was assumed as a serious delay, based on the premise that with longer delays, passengers would leave the airport.)

Under the peak period schedule proposed by CANAVIA, a one hour flight delay could increase space requirements by approximately 255 percent for enplaning passenger, visitor and baggage accumulations at the CBD terminal and by approximately 150 percent at the airport terminal. This latter figure is less than the theoretical maximum because it was assumed that STOLmobiles would not be dispatched to the airport under severe delay conditions and only those passengers arriving by other modes would have to be accommodated.

The accommodation of passengers in the city is more convenient for all delay conditions because they are located closer to their points of origin and other forms of transportation or entertainment, as opposed to being stranded at an airport.

5.13 Interaction with STOLport Layout

Passenger terminal building requirements are only one element of each of the four airport options examined. The functional layout and area requirements of passenger facilities will be influenced by the airport concept being considered as follows:

1. Zero terminal facilities airport - envisages that all passenger processing would take place off the airport with only emergency shelter available near the aircraft; integration of emergency passenger facilities with other airport facilities would be very simple under this concept.

2. Centralized airport facilities - envisages that all facilities including passenger handling, flight operations, equipment maintenance and hangar facilities would be provided in a single multi-purpose building at the airport. Consideration must therefore be given to bulding location, road access parking and the inter-relationship between the aircraft apron and the terminal building.

3. Decentralized airport facilities - envisages that a separate structure would be provided for each main activity at the airport. A separate special purpose terminal meeting all requirements associated with passenger handling would be provided. Airport related considerations would be similar to that for the centralized concept.

4. Integrated facilities - each main activity would be housed in a separate structure. However, the passenger terminal would be linked functionally and aesthetically to other buildings in order to improve operating efficiency and to permit the sharing of common use facilities. In addition to the consideration identified for concepts 2 and 3, the inter-relationship between the activities accommodated within the various buildings, airport expansion capability and flexibility must also be taken into account.

The examination of the interaction between terminal and airport concepts is contained in Chapter 9.0 Evaluation of Alternative Airport Concepts.

6.0 GROUND ACCESS

6.1 Background

The STOL concept envisages a city centre to city centre shuttle service. The 1974-76 Demonstration project showed that 87 percent of the weekday passengers had either originated or terminated their trips in the CBD of one of the paired cities. This high concentration of traffic in a small geographic area provides an opportunity for a dedicated shared road vehicle for transporting passengers between the CBD and the STOLport.

The project assumes that a public transport service will be an integral part of any STOL system concept for inter urban transport. This study further assumes that the public transport system will, as a minimum, incorporate the essential features of the STOLmobile service, the feasibility of which was proven during the 1974-76 Demonstration project.

Except for a STOLmobile service, none of the three airports under consideration will be served by public transit in the foreseeable future. The three available modes of public access will therefore be:

- private road vehicles,
- taxis,
- STOLmobiles.

The study assumes a free user choice of access mode, but parking charges on private vehicles may be levelled at airports. This is particularly true at Toronto Island, where there is an acute shortage of space for surface parking.

6.2 Air Passenger Traffic Demand

Annual Passenger Traffic

The annual air passenger traffic demands for determining ground access requirements and parking are based on forecasts and demand analysis identified in Chapter 2.0 System Definition & Traffic Demand Analysis.

6.3 Choice of Airport Access Mode

Five surveys identifying the travel mode preferences of air passengers using the STOLport access road systems were carried out during the 1974-76 Demonstration project. The results of these five surveys are summarized in the following table:

Ground Time Mode	Percentage of Passenger Trips by Mode					
	Accessing the STOLport			Egressing the STOLport		
	Maximum	Minimum	Average	Maximum	Minimum	Average
STOLmobile	45	35	39.8	56	50	52.8
Taxi	22	14	19.0	18	11	13.0
Auto & Other	47	34	41.2	39	30	34.2

Table 14 Modal Choice Ground Access System

Air passengers use a variety of modes for accessing and departing an airport even on a single round trip. For example, a departing resident passenger may be dropped off at his departing airport from a private car, use the STOLmobile for travelling downtown (at the destination airport), return to the airport by private car and upon arrival (at the home airport), take a taxi home.

The degree of utilization of the various modes for accessing and leaving airports during the STOL demonstration project is shown on Table 15.

Access/Egress Mode	Mode Utilization Passenger (%)	
	At Least One Trip End	Both Trip Ends
STOLmobile	35.0	32
Taxi	18.0	4
Automobile	32.0	21
TOTAL	42.5	57

Table 15 Modal Choice Distribution By Trip End

The information about choice of mode obtained during the STOL demonstration project reflected public preference (averaged over two directions of travel). In order to increase the usefulness of the information, the available data was analyzed as part of the current study and estimates of modal split were made for four categories of air passenger movements on the roads system, as follows:

- Departing residents travelling to the local airport;
- Departing residents egressing the destination airport;
- Returning residents accessing the foreign airport;
- Returning residents egressing the local airport;

The derived modal choice coefficients for the three STOLport in the system are shown in Table 16.

Passenger Category	Trip Direction	Percent of Passengers		
		Automobile	STOLmobile	Taxi
Departing Residents	To Local Airport	47 *	38	15
	From Foreign Airport	28	58	14
Returning Residents	Accessing Foreign Airport	35	42	23
	Egressing Local Airport	40 *	48	12

Table 16 Derived Modal Choice Coefficients

* The 7 percentage point difference reflects the number of vehicles which did not stay at the STOLport.

6.4 Ground Access System Demand

The planning peak day traffic demand on each element of the ground access system was based on the derived model split and was estimated separately for each of the three STOLports in the system.

STOLport	Person Trips				Total
	Traffic Direction	Automobile	STOLmobile	Taxi	
Toronto	Inbound	422	406	190	1,108
	Outbound	350	536	132	1,018
Montreal	Inbound	336	327	155	818
	Outbound	278	434	106	818
Ottawa	Inbound	260	259	125	644
	Outbound	215	344	85	644

Table 17 Planning Day Road Access System Demand By Mode

6.5 STOLmobile Requirements

The STOLmobile service will be flight specific at each airport, therefore a minimum of one vehicle will be required to serve each arriving and departing aircraft. The peak occupancy of the vehicle will be a function of the aircraft capacity (54 seats for the Dash 7), the peak period aircraft load factor on the planning peak day and the variation in modal choice by passengers on the four ground segments of their trip journeys.

STOLport	STOLmobile Trip Direction	Planning Day Air Passenger Traffic	Scheduled STOLmobile Trips	STOLmobile Passengers	
				Average	Peak
Toronto	To STOLport From STOLport	406 536	29 29	14 18	19 26
Montreal	To STOLport From STOLport	327 434	24 24	14 18	20 27
Ottawa	To STOLport From STOLport	259 344	19 19	14 18	18 24

Table 18 Estimated STOLmobile Loadings

The maximum capacity required for the STOLmobile is 30 passengers. An exception is the Toronto Island system where there may be a requirement for the STOLmobile to serve passengers arriving at a proposed off airport terminal by taxi or automobile. In that case, if a single vehicle is to serve both the downtown and local terminal, a 50 passenger vehicle would be required including standing capacity.

6.6 Vehicle Traffic Demands

Automobile Occupancy

The level of trip making by automobiles and taxis is both a function of the person trips made by each mode and the vehicle occupancy by air passengers. Vehicle occupancy data was not reported for the STOL demonstration project and CTOL experience is not considered reliable because of the wider geographic market served by most major CTOL airports. Vehicle occupancies for the CTOL domestic sector in larger centres are of the order of 1.2 to 1.3 air passengers per vehicle. On the shorter access distances associated with STOL services, there would be less incentive to share vehicles and therefore an average occupancy of 1.1 air passengers for both automobiles and taxis was assumed.

Seasonal Variations in Demand

The use of private automobiles was shown to be seasonal, according to the demonstration project surveys. Since the season in which the peak planning day occurs is not determined, two assumptions were examined for purposes of selecting the appropriate average automobile utilization factor. These were that maximum daily person trips were either a product of:

a) The average weekday traffic and the peak surveyed private automobile utilization rate, or

b) The planning day traffic and the average surveyed private automobile utilization rate.

The comparison of the two assumptions showed:

Daily Person Trips by Automobile
(1,000 passengers)

	Assumption (a)	Assumption (b)
Access to Airport	499	510
Egress from Airport	414	424

Assumed Modal Split Factors

Since the two methods gave comparable results, method (b) was used for reasons of consistency in the use of the planning peak day traffic values as the basis of all demand calculations. Again, the planning figures are not intended to reflect the absolute peak demand on the system, but rather a demand level being between the average demand and the absolute peak demand. The average factors calculated for utilization of all three access modes were adopted for study purposes.

Mode	Average Percentage Utilization	
	Access to STOLport	Egress from STOLport
STOLmobile	40	53
Taxi	19	13
Automobile & Other	41 *	34 *

Table 19 Assumed Modal Split Peak Planning Day

* 7 percentage point difference assumed to reflect drop offs of departing passengers.

Modal preferences will vary for each of the four ground trip segments discussed previously. The factors shown in Table 19 were assumed to apply.

Peak Hour Demand

The peak hour traffic demand volumes on the airport access road system are a direct function of the flight schedule for each airport. Departing residents will place the heaviest demand on the road system because they frequently use automobiles and taxis combined (62 percent for outbound residents and 52 percent for returning residents).

Assumed schedules for the mature system show that there could regularly be two morning departures from each airport within 15 minutes of each other followed by a one hour elapsed time. The traffic flows to the two departing flights will overlap with 75 percent of the traffic for the first departure and 100 percent of the traffic for the second departure occurring in the same hour.

The peak hourly morning vehicle flows therefore will be as follows:

STOLport	Peak Hour Person Trips			Peak Hour Vehicles (Excluding) STOLmobiles)
	Total	Autos	Taxis	
Morning Peak Hour				
Toronto-Ontario (75%)	31.5	14.8	4.7	17.7
Montreal (100%)	46.7	21.9	7.0	26.3
	78.2	21.9	11.7	44.0
Montreal-Toronto (75%)	32.3	15.2	4.8	18.2
Ottawa (100%)	42.0	19.7	6.3	23.6
	74.3	34.9	11.1	41.8
Ottawa-Toronto (75%)	28.7	13.5	4.3	16.2
Montreal (100%)	38.2	18.0	5.7	21.5
	66.9	31.5	10.0	37.7
Evening Peak Hour				
Toronto-Ottawa	42.0	19.7	6.3	23.6
Montreal	46.7	21.9	7.0	26.2
	88.9	41.6	13.3	49.8
Montreal-Toronto	43.0	20.2	6.5	24.2
Ottawa	42.0	19.7	6.3	23.6
	85.7	39.9	12.8	47.8
Ottawa-Toronto	38.2	18.0	5.7	21.5
Montreal	38.2	18.0	5.7	21.5
	76.4	36.0	11.4	43.0

Table 20 Planning Day Peak Hour Vehicle Flows

The peak demand by road vehicles in the outbound direction from the STOLport will occur during the afternoon when residents return. Since arriving passengers place an almost instantaneous demand on the road system, there will be little or no opportunity for peak spreading.

6.7 Parking Demand

Effect of Trip Duration

The STOL demonstration project identified the following average trip duration distribution by day of departure.

Length of Stay	% of Daily Trips				
	Mon.	Tues.	Wed.	Thurs.	Fri.
Non Return	37.8	27.6	31.5	40.0	44.7
Same Day Return	37.0	41.4	39.7	36.7	33.9
Overnighting					
One Night	16.7	14.5	11.6	10.0	8.8
Two Nights	-	11.4	9.9	10.0	3.4
Three Nights	3.8	-	1.7	2.7	-
Four or More Nights	3.8	5.2	5.6	0.7	9.2
TOTAL DAILY TRIPS	270	290	302	300	295

Table 21 Trip Duration and Length of Stay

While no statistics were reported, it is highly unlikely that non-returning passengers would leave parked vehicles at the STOLport. It is therefore assumed that on average, approximately 36 percent of the weekly passengers would not require parking.

Trip Duration

The STOL Demonstration project carried out detailed analysis on the length of stay of passengers using the experimental STOL service. Information from the Data Report is summarized in the previous table.

It is assumed that non-returning passengers do not park their vehicles at the STOLport. The peak accumulation of parking would occur by the afternoon of the third day. Parking requirements were estimated on the basis of 1,000 returning residents. The peak accumulation is shown on Table 22.

	Passengers Parking Automobiles	Automobiles Parked	Peak Parking Accumulation
Same Day Return	400	363	280
Overnighting:			
From Day 1	130	118	104
From Day 2	177	162	138
Day 3	240	218	218
TOTAL			740

Table 22 Parking Requirements/1000 Departing Residents

Effect of Inter-City Competing Modes

The effect of competing modes on parking was assessed for the Toronto/Montreal/Ottawa Triangle based on STOL demonstration project statistics for the Ottawa/Montreal route.

The competitive situation on the Toronto/Montreal and Toronto/Ottawa routes will be more favourable toward STOL, so that a lower ratio of non-returning passengers can be expected. This figure could be as low as 20 percent on the Toronto/Montreal and Toronto/Ottawa routes in which case parking requirements would be greater since a larger proportion of departing residents would find it convenient to park their automobiles. Assuming the non-returning sector were to drop from 36 percent to 20 percent, parking requirements would increase at all airports. The sensitivity of parking demand to the non-returning residents factor is shown in Table 23:

	100% RETURNING STOL	36% NON-RETURNING STOL	20% NON-RETURNING STOL
Toronto	330	243	313
Montreal	260	184	221
Ottawa	177	130	155

Table 23 Effect of Non-returning Factor on Parking

7.0 AIRPORT SERVICES AND AIRPORT SUPPORT

7.1 General

A common procedure at most airports is to provide separate facilities to accommodate the following airport services and support functions:

- airport and airfield maintenance;
- apron services;
- crash, fire fighting and rescue.

At smaller Canadian airports, it is common to provide a combined services building (Transport Canada document AK-61-48-200) to house facilities for airport maintenance vehicle storage. CFR; maintenance; workshops and employee accommodation. Apron services, however, are almost without exception the responsibility of private operators who either provide or lease separate garage facilities.

For private STOLports, the provision of accommodation for all three of the functions under discussion would be the responsibility of the private air carrier. Therefore, a logical extension of the existing Transport Canada practice at small airports would be to accommodate all support activities in a single building. All three require approximately the same standard of building, and accommodating them in a single structure would not only result in a more efficient and cost effective building, but could also provide better utilization of maintenance staff.

This recommended practice was shown to be effective during the Transport Canada STOL demonstration project where the responsibility for both flight and airport operations was assumed by a single agency.

7.2 Apron Services

Passenger Transfer

In order to achieve rapid aircraft turnarounds and to eliminate the costs of tugs and loading bridges, it is proposed that aircraft docking be power-in and power-out. The number of operational parking positions will not exceed three at any of the airports under consideration and if the positions are centered on the air terminal building, the walking distances from the terminal exit to the most distant aircraft should not exceed 75 metres. While exposed walking distances of these distances are not excessive, it is suggested that a canopy be constructed along one edge of apron from the terminal gate to a point opposite the aircraft loading door to provide passenger protection.

Other methods of improving passenger comfort would be to allow STOLmobiles to park on the apron near the aircraft door or to provide mobile terminals capable of directly mating with the aircraft for passenger transfer.

Refuelling

A hydrant refuelling system is proposed for all operating stands at all airports. It is envisaged that fuel storage and aircraft refuelling would be contracted to a fuel supplier in keeping with standard practice at most airports.

The average fuel consumption for the Dash 7 is approximately 900 litres (200 imperial gallons) per block hour. Fuel storage capacity at each airport should equal seven days consumption.

The proposed seven day schedule for the system would generate the following storage demand for a seven day period:

STOLport	WEEKLY DEPARTURES	AVG. BLOCK TIME/ FLIGHT	FUEL STORAGE (Litres)
Toronto	166	1.2 hours	180,000
Montreal	139	1.2 hours	150,000
Ottawa	108	0.9 hours	87,000

Powerstart

The flight schedule allows sufficient time for all engine starts to be made by a single mobile power unit. Therefore, under normal circumstances only two mobile units will be required, one as the primary facility and the second as a stand-by.

De-Icing

Mobile de-icing units will be required at all airports. The assumed schedule results in a theoretical requirement for more than one de-icing unit both at the Toronto or Montreal STOLports because the first two morning departures at each airport are scheduled to occur within a fifteen minute period or less. However, both airports will have hangar facilities and these could be used for aircraft storage during periods of anticipated icing conditions. Therefore, a single de-icing unit should be adequate at all three airports.

Catering

In-flight services could include bar, beverage and food services. The demand for hot meals will not be sufficient to justify provision of flight kitchens at any of the three airports under consideration. If necessary, hot food could be transported to the airport from off-airport kitchens and kept warm in specially constructed insulated containers.

Cold snacks, bottled and canned beverages and other bar items could either be provided from an off-airport commissary or space could be provided in the airport operations building.

Security

Mandatory passenger security inspection is not envisaged for domestic STOL services using aircraft of the Dash 7 passenger capacity.

A standard security fence separating the airside and public areas is suggested for airfield security. Two access points to the airfield and apron are recommended: control gate located immediately adjacent to the operations building, to permit the attendant responsible for its operations to be assigned other functions in parallel nearby. The other gate may be automatic.

Sewage Collection

All three STOLports are serviced by gravity flow sanitary sewers discharging into municipal sewage treatment and disposal facilities. Since only domestic air services are involved, it is proposed that aircraft sewage be discharged directly into these municipal systems using standard toilet servicing bowsers and on-airport discharge stations located near the aircraft parking aprons.

Incineration

The disposal of cabin refuse does not require the same attention as that for international flights, therefore, aircraft garbage should be considered as industrial and be handled with other airport garbage by either municipal or private services.

7.3 Airport and Airfield Maintenance

Snow Removal

All three STOLport sites are subject to heavy snow falls during a four to six month period. The aircraft operating surfaces which would have to be kept free of snow on a priority basis are as follows:

Facility	Area (Square Metres)
Runway	22,500
Aprons (3 portions)	8,400
Taxiway	15,000
Total:	45,900

The FAA Advisory Circular 150/5220-11 dated 4/10/78 recommends that airports having 40,000 or more annual air carrier operations, require a snow removal time not exceeding one half hour. Given that only one operational runway is required at STOLports, a service level of fifteen minutes is recommended by the current study in order to take advantage of the relatively short time slots available between succeeding aircraft arrivals and departures.

Assuming a critical snow fall rate of 4 inches per hour (10 cm), snow density of 25 pounds per cubic foot and a snow blower efficiency of 70%, and a fifteen minute service level for the clearance of critical areas, the required snow blower should have a capacity of 500 tons per hour. This is within the range of a single FAA class II snowblower; however, a class III blower is recommended to provide reserve capacity.

A class III blower would have a gross weight of approximately 20,000 pounds and 200 net horsepower.

The physical dimensions of the unit should not exceed the following:

- height	- 150 inches	(3.8 metres)
- width	- 108 inches	(2.7 metres)
- length	- 35 feet	(11.48 metres)

Two truck-mounted snow plows are also recommended for clearing of access roads, parking lots and airfield operational areas not accessible to the main snow blower unit. It is assumed that snow which can not be stored on site, would be removed by private contractors.

Other Maintenance Equipment

The following airfield maintenance equipment would also be required unless certain services were contracted out:

- runway sweepers	2
- tractor loader	1
- pickup truck (1 ton)	1
- van (3/4 ton)	1
- riding power mower	1
- runway sander/spreader	1

Crash and fire fighting vehicle requirements are outlined in Part 9.0 - EMERGENCY SERVICES.

7.4 Building Requirements

It is recommended that the airport support building accommodate the following:

- crash fire fighting and rescue services;
- apron and airport vehicle maintenance;
- parts and supplies storage;
- vehicle storage;
- related operating and maintenance personnel.

The scale of operations envisaged at STOLports would not justify the provision of full vehicle repair services on the airport. The close proximity of STOLports to urban centres would make it economic to service and repair most highway licenced vehicles at existing off-airport commercial garages. The on-airport facilities therefore, would only be required to service those vehicles which could not be driven off the airport and for emergency repairs of all equipment. Similarly, it would not be necessary to store a full range of parts for those vehicles and equipment which could be regularly serviced at commercial facilities. As a consequence, the primary requirement for on-airport space would be to accommodate the crash, fire and rescue vehicle and its associated storage requirements: the storage and garaging of vehicles which require heated accommodation: the service of special equipment and for emergency repairs.

Because of the simple nature of these operations, it is proposed that the equipment maintenance building space also be used for the overnight storage of equipment requiring protection or heated storage.

A modular building consisting of eight 11 x 5 metre bays and having a total area of 440 square metres should be provide adequate space to accommodate the outlined activities.

The suggested space allocation within the building would be as follows:

Activity	Square Metres
- apron and airport equipment servicing and storage	220
- crash, fire and rescue vehicle storage	55
- parts, tools and mechanics work area	55
- administration and employee space	55
- fire chief, chemical storage	30
- general storage	25
TOTAL AREA	440

8.0 AIRCRAFT MAINTENANCE

8.1 General

The standard procedures for aircraft maintenance is to carry out pre scheduled block inspections at approved time periods expressed in terms of cumulative aircraft block flying time. For the Dash 7, the standard complete maintenance cycle covers a 17,280 hour operating period with insepctions as follows:

A. 120 hours
B. 24 hours
C. 14,400 hours with multiples of 2C, 3C, 4C and 6C.

Block maintenance procedures result in the aircraft being out of service for significant periods therefore, back up aircraft are required to avoid interruptions in service. For most operators, particularly those with only a few aircraft in their fleet, this procedure has two major disadvantages:

- significant, extra capital, leasing or charter costs could be incurred in providing back up aircraft:

- higher maintenance costs because of the significant under utilization of staff between inspections.

In order to spread the maintenance work load and to avoid extended out-of-service periods for the aircraft, an equalized maintenance program has been developed for the Dash 7.

8.2 Program Content

The periodic maintenance and inspection requirements for the Dash 7 are specified in the Maintenance Review Board approved maintenance program outlined in the de Havilland Aircraft Maintenance Manual PSM 1-7-2. The equalized maintenance program allows maintenance to be carried out sequentially in a series of small packages during normal overnighting and weekend aircraft layovers. As a result, aircraft can remain in more or less continuous service.

The equalized maintenance program can be summarized as follows:

It consists of a series of work cards arranged by aircraft areas and inspection frequencies. The combination of work cards required to form a work package for any particular check is determined by reference to "equalized inspection" index cards.

Although primarily intended for equalized inspections, the same work cards can also be used to form work packages for a block inspection program, by reference to "block inspection" index cards.

Reminder cards, to be reviewed at each inspection contain details of out-of-phase items; other cards provide a list of consumable items required during inspections.

The system has been simplified and the number of work cards reduced by dividing the aircraft into five major work areas as shown on Figure 6.

The program can be used in one of two ways:

- the first is based on 144 checks at 60 hour intervals;
- the second is based on 72 checks at 120 hour intervals.

Both programs make up a complete cycle of 8.640 hours: the choice of program is determined by such factors as aircraft availability and manpower and hangar requirements.

8.3 Maintenance Hangar Considerations

The commuter service envisaged in this study requires that aircraft overnight at all three STOLports in order to meet the early morning departure times preferred by business travellers. These overnighting aircraft would be out of service and therefore available for service checks for a minimum period of 7.5 hours nightly and some would also be available on weekends because of reduced schedules.

A major maintenance consideration is whether the hangar facilities necessary for service checks should be provided at more than one airport in the system.

Analysis showed that services hubbing on Toronto Island airport provide the greatest maintenance load for the following reasons:

- 42% of the aircraft fleet overnight there.
- the airport has the heaviest flight schedule.
- the average block time per flight was equal to or higher than that at the other two airports.

Toronto Island, therefore is considered to be the best choice for the main aircraft maintenance facility.

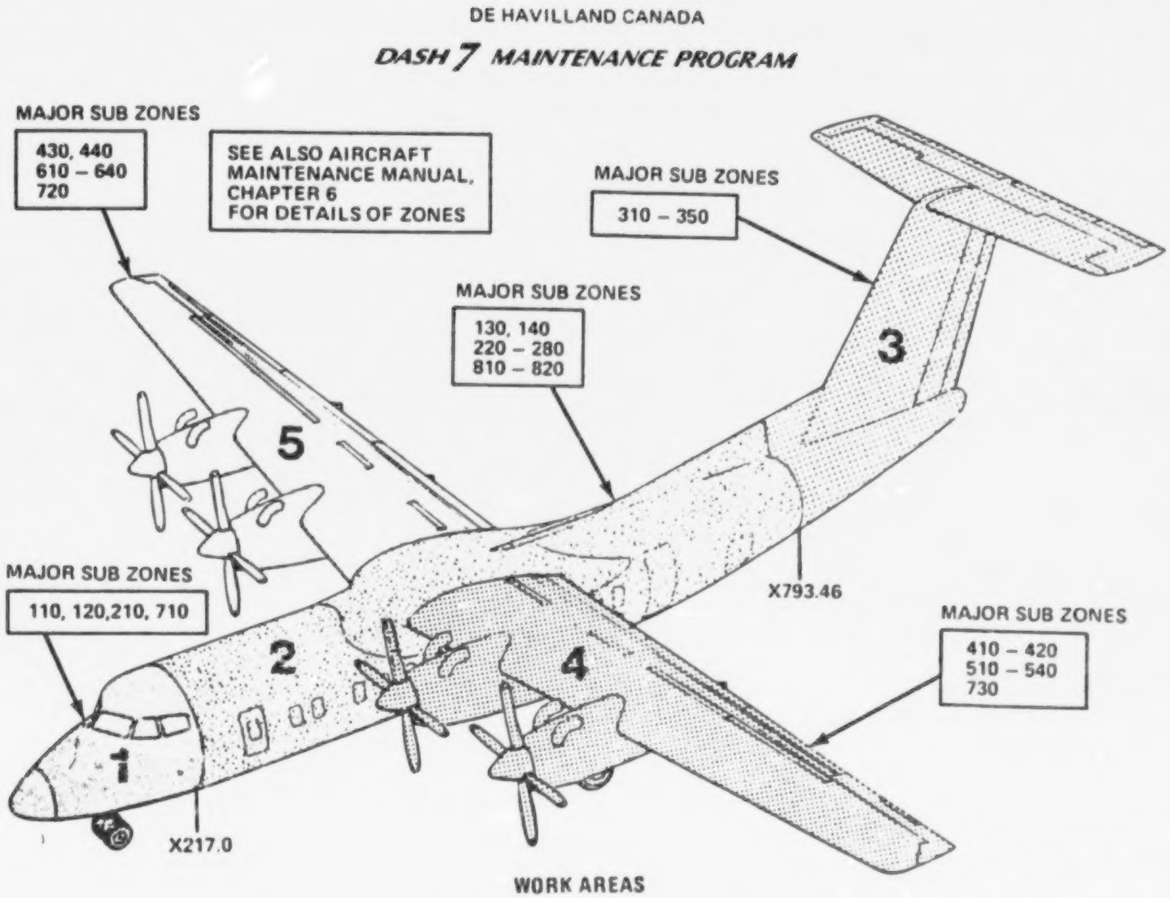

DE HAVILLAND CANADA
DASH 7 MAINTENANCE PROGRAM
MAJOR SUB ZONES
430, 440
610 – 640
720
SEE ALSO AIRCRAFT MAINTENANCE MANUAL, CHAPTER 6 FOR DETAILS OF ZONES
MAJOR SUB ZONES
310 – 350
MAJOR SUB ZONES
130, 140
220 – 280
810 – 820
3
5
MAJOR SUB ZONES
110, 120,210, 710
X793.46
MAJOR SUB ZONES
410 – 420
510 – 540
730
2
4
1
X217.0
WORK AREAS

figure 6

DASH 7 WORK AREAS

A simplified risk analysis showed that a single hangar could be justified at Montreal primarily to cope with unscheduled equipment outages and to act as a back up facility for Ottawa. A hangar at Ottawa, while desirable, was not judged to be essential.

8.4 Building Alternatives

The analysis showed that a hangar providing up to three aircraft maintenance positions might be required at Toronto Island airport. The hangar areas required to accommodate from one to four aircraft using different building configurations are shown on Figure 7.

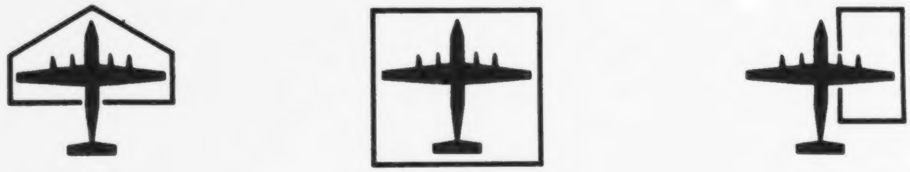
Net approximate space requirements for various hangar types and sizes studied are as follows:

Hangar Type	Area (Square Metres)	
	Total	Per Aircraft
Wing	220	220
Nose	340	340
Single	860	860
Double	1.560	780
Triple (Rectangular)	1.785	595
Triple (Curved)	2.040	680
Four Bay	2.180	560

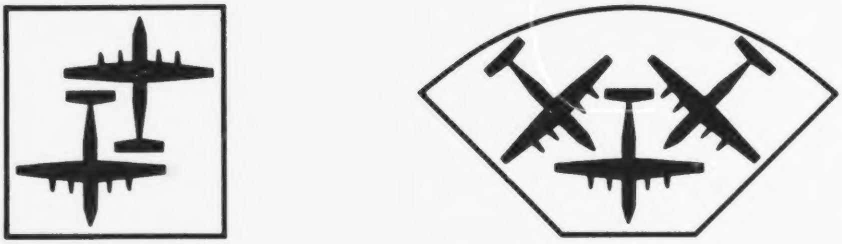
8.5 Support Areas

Workshop, parts storage, inventory storage and control and administration space requirements can be highly variable and must to be assessed in the context of total fleet size, extent to which maintenance is to be carried out off the airport, type of maintenance programme, and the degree of sophistication required in the management and control systems.

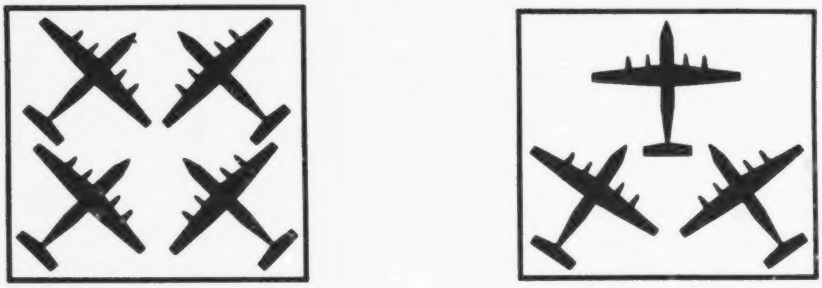
A typical hangar layout developed by the de Havilland Aircraft of Canada Ltd. is shown on Figure 8. The maintenance activities and spaces incorporated in this layout are as follows:



NOSE HANGAR SINGLE HANGAR WING HANGAR



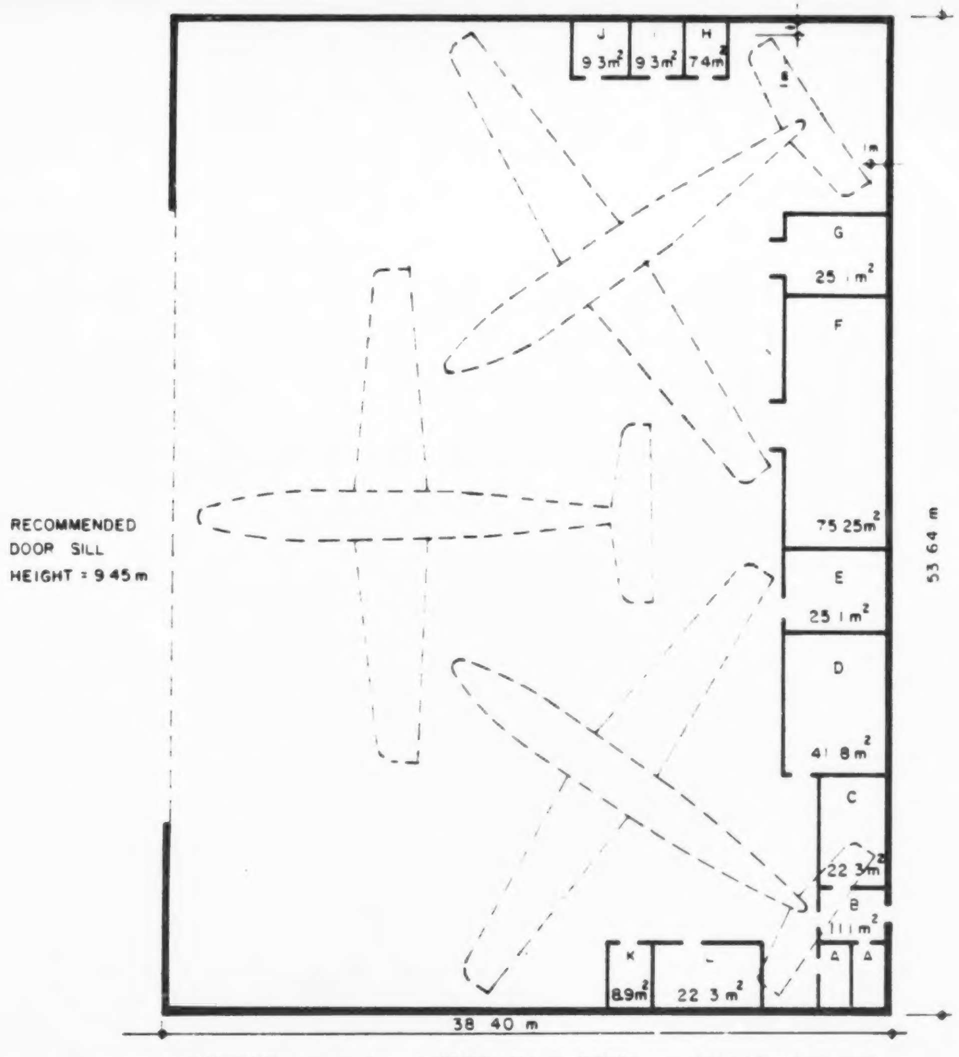
DOUBLE HANGAR CURVED HANGAR



4 POSITION HANGAR TRIPLE HANGAR

figure 7

ALTERNATIVE HANGAR LAYOUTS


J
9 3m^2
9 3m^2
H
7 4m^2
1m
G
25 1m^2
F
75 25m^2
E
25 1m^2
D
41 8m^2
C
22 3m^2
B
11 1m^2
A
A
K
8.9m^2
L
22 3 m^2
RECOMMENDED
DOOR SILL
HEIGHT = 9 45 m
38 40 m
53 64 m

A WASHROOM (M & F)
B RECEPTION
C HANGAR MANAGER'S OFFICE & RECORDS
D MAINTENANCE OFFICE STORES, TOOL CRIB, DARK STORAGE AREA
E. RADIO / INSTRUMENTS
F PROPELLER & ENGINE SHOP
G HYDRAULIC SHOP
H BATTERY SHOP
I PAINT, SOLVENTS
J. WHEEL STORAGE & WHEEL/TIRE ASSEMBLY
K BATTERY LEAD/ACID (WELL VENTILATED)
L ELECTRICAL SHOP

figure 8

DE HAVILLAND HANGAR CONCEPT

Activity	Floor Area (Square Metres)
Administration and Related	48.5
Parts and Tool Storage	41.8
Avionics	25.1
Propeller and Engine Shops	75.3
Hydraulic Shop	25.1
Battery Shop and Storage	16.3
Wheel Storage and Shop	9.3
Electrical Shop	22.3
Part Storage	9.3
Sub-total	273.0
Aircraft Storage	1.787.0
Total Area	2.060.0

If large scale maintenance facilities are required, they are best accommodated in a special service building along one side or end of the hangar. The advantage of such special facilities include:

- a more efficient functional arrangement;
- a higher quality environment for personnel and for sensitive maintenance functions such as avionics equipment repair;
- a controlled environment for computers and other electronic equipment;
- better control of visitor flow and other security.

For the scale of operations envisaged in this report, the approximate area required for self-contained maintenance facilities can vary from approximately 300 sq. metres to 500 sq. metres.

9.0 EMERGENCY SERVICES

It is accepted practice to provide emergency services at all airports particularly those having significant levels of scheduled air carrier traffic. Although community-based emergency services may be provided within reasonable response times, as applicable to any transportation or industrial facility, designated or dedicated airport emergency response teams are also established to assist in a primary and/or interim capacity during a variety of critical situations. Aircraft or structural fires, perilous aircraft landings, passenger evacuations, vehicular incidents, chemical spills, medical emergencies and breaches of security such as bomb threats are all airport based hazards which are to be minimized in order to spare death, injuries and trauma, and protect private and public property.

At conventional airports these airport-based emergency services are based on standards described in ICAO's Airport Services Manual Part 1, FAA's FAR 139, and Transport Canada's AK 12-03-001 Crash Firefighting and Rescue Services Standards (see Appendix A). while STOLport requirements are not specifically identified in these documents, it is expected that these CTOL standards be applied as if the STOLport was a small CTOL airport. ICAO's STOLport Manual does in fact refer to its own Airport Services Manual Part 1 for crash, fireighting and rescue (CFR) requirements.

The following addresses the situation of identifying STOLport requirements in the context of a single carrier, privately operated airport.

9.1 Emergency Planning

ICAO, FAA and Transport Canada recommend the development of an official airport emergency measures plan under the direction and control of the airport manager. This detailed plan is to provide for what is referred to as the 3 C's, command, communication and coordination. It should contain items such as a grid map, identifying topographical and other significant features (e.g.) water supplies, all weather access routes; a source reference of the airport's chain of command during an emergency, emergency agencies and contacts; and a step-by-step methodology for responding to every conceivable airport incident at any rendezvous point.

Staff rosters, equipment and supplies lists, emergency and post-emergency procedures are to be included in these plans as well, and provision must be made to have them circulated to airport staff and community agencies for familiarization and official coordination and implementation. Inventories of emergency equipment suppliers and services are provided at the rear of the report.

It is also recommended that aircraft evacuation techniques training be coordinated through local community authorities who may be called upon to assist in the event of an aircraft incident.

9.2 Level of Service - All Types of Emergencies

Until such times as it is proven that a lesser level of service is adequate it is recommended that the level of protection provided at STOLports be based on that applicable to conventional CTOL airports.

Most STOL services are considered comparable to CTOL airport Category 5 (ICAO, Transport Canada) or Index A (FAA).

Where CTOL and STOLport requirements differ is not in the quality of protection proposed but is in the proposed approach. For STOLports located in the central business district (CBD) of a metropolitan area where high quality emergency services are readily available, the STOLport operator should propose to furnish specialized aircraft/airport related emergency services for rapid intervention and interim hazard control (subject to insurance and licencing agreements). Response personnel might not be exclusively dedicated to emergency services functions as they are at remote STOL or larger CTOL sites due to the proximity of emergency services and the passenger loads handled. One may also suggest that in the event that a distressed aircraft is capable of reaching an international airport with superior CFR services, the aircraft may be diverted to an international airport. This alternative must be coordinated in advance with representative CTOL airports, CFR and ATC staff and documented in the official STOLport emergency measures plan.

Figure 10 illustrates the contrasting concepts involved in considering emergency service requirements at STOL and CTOL airports.

Coordination

STOLport emergency services including Crash Firefighting and Rescue Services are to be coordinated under the authority of the Airport Manager and under the technical direction of the CFR "Chief".

These services should wherever possible be made compatible with local Transport Canada CFR services and community-based protection services.

Critical Response Time

Airport emergency response standards call for intervention within three minutes for incidents occurring within the airport boundary, and for urgent response to those areas beyond. The National Fire Protection Association (USA) calls for response within 2 minutes. Aircraft related emergencies are considered to be of greater priority due to the greater hazard involved (2 minute cabin evacuation time for CTOL aircraft), and as a result are dealt with separately within operational standards manuals and emergency plans.

Hours of Operation - CFR

According to Transport Canada AK-12-03-001, CFR and other emergency services at STOLports are to be made during core hours, available 30

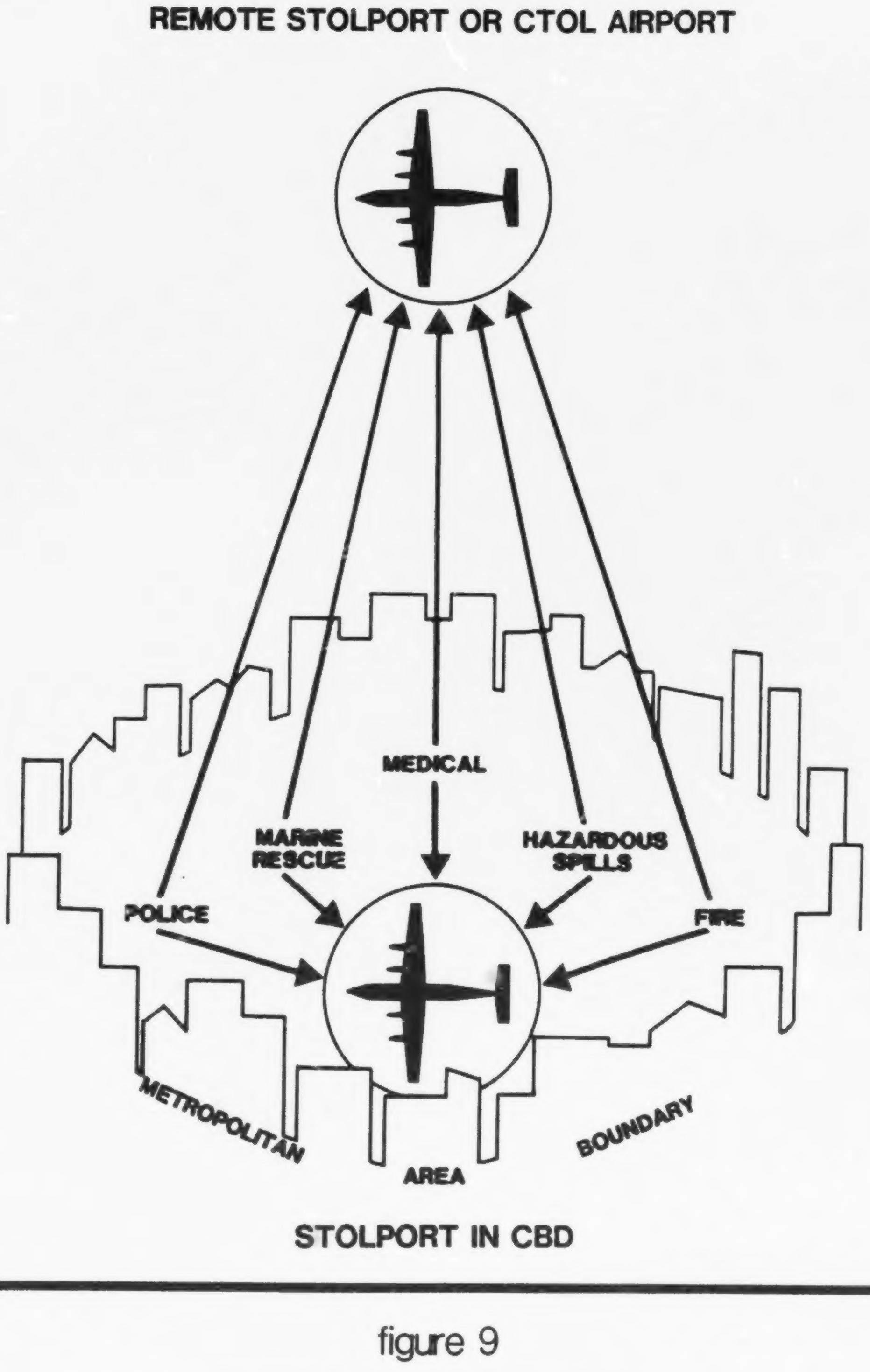

REMOTE STOLPORT OR CTOL AIRPORT
MEDICAL
MARINE RESCUE
HAZARDOUS SPILLS
POLICE
FIRE
METROPOLITAN
AREA
BOUNDARY
STOLPORT IN CBD

figure 9

EMERGENCY SERVICES RESPONSE CAPABILITY

minutes before first flight departure or arrival to 30 minutes after the day's last scheduled flight arrival or departure.

Critical Area

Defined as those areas adjacent to the aircraft fuselage extended to those points beyond in which a large fuel fire would not melt an aluminum fuselage regardless of fire exposure time 513 m^2 - 766 m^2 for Category A/5 Airport.

Maximum Critical Distance

The maximum critical distance to be achieved during an incident involving a Dash 7 operating in the STOL mode is likely 800 to 1,000 m. A rapid intervention vehicle and major foam tender is capable of response in approximately 1.9 minutes and 2.23 minutes respectively.

Structural Fires or Other Incidents

Although CFR organizations at CTOL or STOL airports do not have a specific mandate to provide assistance in the event of a structural, or vehicle fire, grass fire, security incident or medical emergency, due to their dedication to more specialized aircraft emergencies, they are, however, expected to assist due to their proximity and expertise, provided that there is no hazard to meeting the requirements of a possible aircraft incident. As in all situations, supportive community-based CFR services will be alerted on an immediate basis and the airport manager will be advised regardless of the level of emergency.

Marine Incidents

If an aircraft lands in a waterway beyond airport property, STOLport based CFR staff will alert community based emergency agencies of the mishap and attend to the incident as quickly as possible. Although STOLport-based CFR resources will be utilized, the responsible rescue agencies such as the Canadian Coast Guard, National Defense or local Harbours Board will assume the primary directing role due to their jurisdictional mandate and appropriate marine capability e.g. marine vessels and training. STOLport CFR staff will be expected to assist, and loan and/or operate specialized aircraft rescue equipment e.g. forcing tools, taking the operational lead if necessary in these circumstances.

Personnel Requirements and Training - CFR

At Transport Canada owned and operated CTOL airports professional firefighters are dedicated exclusively to CFR and other emergency duties due to historical precedent, greater and more mixed passenger and aircraft traffic volumes to be served, and the remoteness from community-based CFR services. One Fire Chief, nine firefighters and seven auxilary agents per shift are suggested for a Category 5 Airport.

ICAO and FAA do not specify exact numbers of staff to be utilized leaving the staffing decision up to the discretion of the airport manager, in accordance with the following criteria:

- sufficient numbers of people to operate vehicles and equipment, ensuring maximum use of equipment and effectiveness of effort. The FAA requires 50% of all emergency vehicles and equipment to be deployed during primary intervention;
- sufficient staff to operate communications facilities during an emergency situation until the hazard is over, or relief staff are available, or supplementary assistance is installed.

At privately operated STOLports, where airline traffic volumes are typically less; the aircraft to be served smaller, and easier to land and evacuate; and community-based CFR services could be in sufficient proximity to respond within an acceptable period of time, it is proposed that 1 to 2 certified firefighters and an indeterminate number of trained auxiliary firefighters (per shift) be utilized at each STOLport in the interests of economy.

Secondary teams may involve individuals who follow up in auxiliary vehicles, staff who are standing in for those occupied elsewhere, or those who could perform special duties under extraordinary circumstances e.g. bookkeeper becomes interim media liaison.

It is recommended that STOLport operators assign roles to all available staff during emergency situations and encourage training in first aid courses such as CPR. Staff should be aware of their respective team leaders and team-mates, and should be sufficiently familiar with their emergency and post-emergency duties in order to respond automatically and carry on in the event of loss of supervision for whatever reason.

Training

CFR crews are required to take crash, firefighting and rescue training initially for certification as well as regular refresher training to maintain currency in knowledge and experience. "Hot" fire drills on a regular basis and simulated disaster exercises on an annual basis are required by ICAO, FAA and Transport Canada.

All staff are also expected to be thoroughly familiar with airport topography, aircraft and vehicular movement routes, and the capabilities and responsibilities community protection agencies. CFR staff should also be skilled in CFR vehicle maintenance procedures, ancilliary equipment use, special terrain driving skills and personal conduct. Expertise in marine rescue and watermanship is also an asset to STOLport operations adjacent to bodies of water.

9.3 Clothing - CFR

The following protective clothing is recommended for firefighting personnel by ICAO and Transport Canada for use at CTOL and STOL airports.It is noted that in rescue operations the feeling of pain (eg) facial pain, was apparently strong enough to delay firefighters from escaping in extreme situations, therefore, protection from pain appears to be as important as protection from burns.

Preferred Method	Effect	Fire Hazard	Prohibit Use On	Advantages	Disadvantages
Low-expansion or medium-expansion foam - foam volume produced 50:20, 21:20 ratios Concentrations - 3,5,6% by volume of water. Can include Protein-base foam agent e.g. Fluorine #28GP28 for Canada	Smothering and cooling effects.	Heterogeneous objects. Solid fires e.g. wood fires, Fluid fires, especially fuel tank fires.	Foam concentrations on live sections of electricity supply systems	Persistence of effect Foam is relatively stable agent	Slow onset of effect. Foam destroyed by polar fluids, e.g. alcohol. Object polluted by fluid released by the foam.
Dry Powder (e.g. sodium bicarbonate	Inhibition of oxidation	Fluid and gas fires. Special fire cases, eg transformers in enclosed spaces.	Fighting fires in installations which must be quickly ready for use again. Fires in outdoor transformers.	Rapid effect	Pollution of object by powder.
Combination Powder/foam	As for foam and powder				
High-expansion foam 200:1,000 ratio	Displacement effect	Indoor premises, irrespective of the nature of the combustible substances contained therein.		No secondary damage	Difficulty of removing large quantities of foam since it is not stable as other types of foam.
Water (jet spray flooding, sprinkler)	Vaporization effect	Wood, textiles, plastics. Special cases eg hangars,outdoor transformers	Fighting light metal fires. Spraying of live electrical systems	Cheap extinguishant available in large quantities	Water damage
Carbon dioxide (gas, plus snow aerosol)	Smothering effect as displacement effect	Incipient fires in fluids and gases. Smouldering fires in sensitive installations. Special cases e.g. engine test beds.	Use of large quantities in enclosed spaces when people are present	No pollution	Little guarantee against reignition. High weight of extinguishers.
Halocarbons (containing fluorine, bromine or chlorine	Inhibition	Incipent fires in fluids	Use of major quantities in enclosed spaces when people are present. Particularly dangerous to spray burning metals because of formation of toxic disintegration products.	Rapid effect with small extinguishant quantities.	No guarentee against reignition Possible toxicity to users
Aqueous film forming foam agent AFFF #28GP74 for Canada	Greater blanketing effect			Greater persistence compatible with dry chemical	Temperature restrictive. Might drain quickly .

figure 10

COMPARISON OF EXTINGUISHING METHODS

Item (Per Person)

1. Proximity Suit/Coveralls

   - heat/water resistent outerwear capable of insulating against occasional flame contact, radiant heat of 0.7 cal/cm^2/sec for 2 minutes and radiant heat of 1.9 cal/cm^2/sec for 1 minute.

2. Insulating/Anti-Chafing Innerwear

3. Breathing Apparatus - self contained

4. Gauntlets - heat-water resistent and flexible

5. Helmet - heat/shock resistent, capable of providing thermal stability and wide area of vision - with moveable visors, storm flap

6. Boots - Reinforced steel toe and heel - heat, skid resistent

9.4 Vehicles and Ancillary Equipment - CFR

STOLport emergency response vehicle estimates are based primarily on ICAO, FAA and Transport Canada criteria for extinguishing agent coverage with further consideration of the following points:

- the STOLport's more compact airfield size and the relative response times of various CFR vehicles;

- the DASH 7's slower ground speeds and reduced runway requirements when operating in the STOL mode;

- less complicated aircraft cabin evacuation due to the DASH 7's smaller passenger capacity (in comparison to other aircraft now flying commuter routes e.g. 727's);

- the availability of on-site CFR resources at municipal sites or community resources in proximity;

- proximity to alternate, international airports with superior CFR capability, and

- sufficient numbers of vehicles to ensure, during downtime, that CFR capability is not reduced by more than 50%.

Facility	Considerations	Space Requirement Transport Canada
1. Personnel Accommodation	Dormitory,	7.4m^2/person on shift
	kitchen,	5.6m^2+1.8m^2/person
	showers, washroom,	0.9m^2person
	games room,	1.8m^2/person on shift
	Offices - Commanding	11.2m^2
	Officer and - Shift Supervisor	9.3m^2
	Muster area/clothing	N/S
	Storage	0.3m^2/person circulation
2. Vehicle Accommodation	Vehicle bay - heated,	Acc. to vehicle size
	Equipment stand-by, Storage,	N/S
	Maintenance Workshop,	9.3^2-23.2m^2
	Mtce. Equipment Storage	N/S
3. Supplies Storage	Environmentally controlled Water Storage,	N/S
	Dry Chemical Storage,	0.8m^3per40kg +2.3m^3 per CFR vehicle
	Foam Compound Storage,	
	Reserves Foam Compound,	0.8m^3per450 kg.
	Maintenance Supplies	N/S
	Storage	2.5m^2
4. Communications/Alert Systems	Fire Alarm/Display Unit Communications	9.3m^2

figure 11

CFR FACILITY REQUIREMENTS

Organizations	ICAO	FAA	Transport Canada	STOLport
Standards (per site) Vehicle Type	DOC 9137-AN/898	FAR 139 AC 150/5210-14 AC 150/5210-6B	AK 12-03-001	Estimate
Rapid Intervention Vehicle (RIV)	1	1	1	0
Medium Vehicle	0	0	0	1
Major Vehicle	1	As required	1	-
Marine Vessels	As required	As required	Harbours Board or Coast Guard Responsibility	Harbours Board or Coast Guard Responsibility
Ancillary Equipment	Refer to documents cited above			

Table 24 CFR Primary Intervention Vehicle Requirements*

* ICAO, Transport Canada Category 5 Airport
FAA Index A Airport

Vehicle Design and Performance Considerations

The following characteristics based on FAA AC 150/5220-14 and 150/5210-6B are of interest when choosing an appropriate intervention vehicle.

- basic	- diesel engine, front wheel steering, four wheel drive - two way radio
- speed	- 0-80 km/h in 25 seconds (light vehicle) 0-80 km/h in 45 seconds (major vehicle);
- simplicity	- requires one person wearing gloves, to operate; - requires a minimum amount of training and orientation; - aerodynamic styling with ample clearances.
- reliability	- primary and back up dispensing systems operating at design capacity; - chassis, traction and suitable systems for rough handling and use on rugged terrain;

- cost-effective	- capital outlay and maintenance costs;
- other design features	- siren, air horn, back up and warning devices; - good visibility from cab; - body - fire resistent, well protected and well insulated; - ample manoeuvering space in cab; - accessible lubrication points; - filler caps with chain fastenings; - standardized tools and accessories; - accessories that re-fasten in one direction only and shall not work loose during operation; - no protruding or sharp objects; - lack of excessive trim and accessories which add to its cost and weight; - upper turret(s) and handling systems are to have sufficient capacity to discharge agents as required; - balanced load capacity throughout body for stability.

FAA FAR 139 CATEGORY A AIRPORT REQUIREMENTS PER AC-150/5210-6B	Extinguishing Agents				
	Protein Foam		Aqueous Film Forming Foam (AFFF)		Dry Chemical Powders*
	Water for Foam Production	Solution Application rate	Water for	Solution Application rate	
	1,830 (gal)	1,100 (gpm)	1,190 (gal)	720 (gpm)	500 (lb)
	6,950 litres	4,164 lpm	4,504 litres	2,725 lpm	226 kg

Table 25 (FAA) Vehicle Capacity Requirements

*The total quantities of dry chemical agent are based on sodium bicarbonate. Potassium base dry chemicals may be substituted in quantities up to 10 percent less by weight. Compatibility with the foam agent is a must. Does not include reserves of compounds.

	Level of Fire Fighting Capability for Index A Airports
Present Requirements FAR part 139 and AC 150/5210 - 12	1900 l Water For Protein Foam 135 kg Dry Chemical 1 Truck-RIV
	and 5,600 l Water For Protein Foam 135 kg Dry Chemical 1Truck - Tender - Major
Proposed Vehicle	3,800 l Water and AFFF Premixed 225 kg Dry Chemical 1 Truck-Medium
Recommended Practices AC 150/5210-6B Similar to recommended ICAO practice	1,900 l Water For Protein Foam 135 kg Dry Chemical 1 Truck-RIV
	and 5,600 l Water For Protein Foam 135 kg Dry Chemical 2 Trucks-Tenders-Medium
Proposed Vehicle	3800 l Water and AFFF Premixed 225 kg Dry Chemical 1 Truck-Medium

Table 26 Proposed Vehicle and Supplies Substitutions
FAA AD/A-053-110

9.5 Ancillary Equipment

Tools to be included with intervention vehicles at each site are listed in source materials previously cited. Final procurement should be based on continued availability and compatibility.

9.6 Supplies - CFR

For operating and training purposes airports should have on hand:

- twice the quantity of extinguishing agents carried on each emergency vehicle;

- a supply of protein foam liquid concentrate for possible runway foaming and;

- training reserves.

Miscellaneous items such as solvents for cleaning and conditioning protective clothing and equipment, batteries or refuse recepticles will also be required.

9.7 Extinguishing Agents

Due to the complex nature of aircraft and fuel fires, a variety of extinguishing agents are recommended for use by ICAO, FAA and Transport Canada. Each type of agent has a specific or preferred use and are to be applied in certain combinations based on chemical composition and effectiveness, performance characteristics under different environmental conditions, cost, and toxicity, level for users.

Primary extinguishing agents are substances such as water, foam or dry chemicals such as Purple K. Water by itself is primarily applied for structural fires, but in combination with foam compounds provides the best available method of aircraft and fuel fire extinguishing and suppression. Foam not only wets and cools flames but smothers them due to its coating action, thereby preventing the spread or reactivation of the fire. Foam is more costly than other agents, is more difficult to apply and store, is more sensitive to environmental conditions such as freezing, wind and decomposition, but is less toxic and damaging to aircraft hulls than other substances. Complementary agents such as fluorine or protein based substances that are added to foam compounds in order to improve the foam's performance effectiveness through increased stability and activation response.

Dry chemicals such as sodium bicarbonate or potassium derivatives, which are less costly to apply and store, may also be used for fire extinguishing. Their overall performance effectiveness is, however, less than foam, and the powders are more polluting than foam or water.

Substances such as halocarbons and carbon dioxide are suitable in sensitive situations involving specialized aircraft fluids or people, but are more toxic to humans than the agents previously described.

9.8 Considerations for Foam Carpets

For fire prevention or suppression the layering of foam on runways is recommended by ICAO, FAA and Transport Canada. Foaming reduces the potential for loss of life or further aircraft damage due to friction spark ignition or fuel spillage, however, it is not as effective for functions such as braking in freezing temperatures.

Under most Canadian climatic conditions 5 cm of foam with an expansion ratio of 10 to 15 is suggested, except in the summer months when low expansion foam is more applicable. Foams, by and large perform better in cooler, damp weather if they are not subject to wind, physical destruction or dilution by precipitation. Since carpets of foam are costly, time consuming to apply, are not always utilized as the final touchdown point, are messy to clean up and subject to the availability of deploying vehicles (and their capacity), their use at STOLports should be discouraged wherever possible in favour of re-routing the distressed aircraft to the nearest CTOL airport having a superior CFR capability.

Item	Malfunctioning Nose Wheel	Wheels-up landing
Width of Pattern	8m	23m
Length of Pattern	450m	750m
Runway Area Covered	3,600m^2	17,400m^2
Water Required	14,400 l	71,000 l
Protein Foam Liquid Required		
- 3% Type	432 l	2,130 l
- 6% Type	865 l	4,260 l

Table 27 Requirements for Runway Foaming* (ICAO) Category 5 Airport

* ICAO Airport Services Manual Part 1 Chapter 14, 1977

9.9 Facilities Requirements, Access Routes

An all weather emergency access route linking public roads and the airside is required for timely intervention by community emergency service units. This road shall be secured with a manual or electronically activated gate at the point of airside areas for security.

9.10 Communications

During any incident communication between site rescue teams, off-site resources, those in distress, and those in proximity is vital.

Provision of public address and fire alarm/alert systems throughout the airport, with the main unit being located at the CFR muster station or at the airport manager's office is suggested.

Also required are NOTAMS, telephone links with direct connection to hospital emergency centres; 2 way radios and vehicle loundspeaker systems. Portable bullhorns are apparently less effective in proximity to a crash situation.

Aircraft Incident

Those in distress shall contact local Air Traffic Control by radio, who will alert the CFR Chief, who will in turn contact site and community emergency services e.g. police, medical, fire and the Airport Manager's office by telephone. Radio contact through ATC will be maintained with the distressed aircraft and those aircraft and airports in proximity. Summoned rescue vehicles will also be kept in contact with ATC by radio. Rescuers will be kept in contact by CFR vehicle loudspeaker.

The airport manager's office will alert secondary site emergency staff by telephone or page and stay in contact by radio. Hospitals will be kept advised by direct telephone connection. Passengers on the ground will be kept advised verbally by specified airport staff such as a media liaison or by public address system.

NOTAMS

Pilots will be advised of incident or the inoperation of CFR services at a site (during maintenance) by filing of a NOTAM. A voice NOTAM is required by Transport Canada if CFR vehicles are out of service for a period of up to 6 hours, and a NOTAM Class 1 by ADIS is necessary for periods greater than 6 hours.

Non-Aircraft Incident

Depending upon the emergency e.g. structural fire, medical emergency, security incident, the distressed person or those in proximity should alert the nearest available airport employee or call local or site emergency services directly. The airport manager's office should be advised subsequently for further action.

9.11 Security

During and after an incident measures should be taken to protect those in distress from the general public. Specified airport staff be summoned to pre-appointed security "stations" prior to the arrival of the police to prevent unnecessary access to the airside or proximity to the hazardous area. Selected airport staff not dealing directly with the rescue may be advised of information suitable for dissemination to the media and the public.

9.12 Special Purpose Facilities

Provisions for interim casualty care in the form of triage area and supportive assistance, and additional transportation of casualties to community medical care should also be considered for implementation in the airport emergency plan.

9.13 Maintenance

Routine, on-going maintenance within the site, will indirectly facilitate operations during and after an incident. CFR vehicle annual inspection reports are to be sent to Transport Canada (KSE) Ottawa prior to September 30th on an annual basis. Snow removal will facilitate access to and from the airside, and contracted janitorial and disposal services can be used to augment the post emergency clean-up operation.

9.14 First Aid Services

Specific airport personnel or from contracted firms should be trained, equipped and available for the provision of first aid to any person on airport property or involved in an aircraft or other incident nearby, their assistance being supplemented by professional medical treatment as quickly as possible whenever required. The official airport emergency plan is to provide for the summoning of doctors, paramedic staff, and ambulances, and should lead to the establishment of emergency communications networks with emergency numbers conveniently posted at key locations near telephones, at radio emergency stations and in applicable management directories. The emergency plan and training of airport staff should also take into consideration the priorities associated with aircraft related emergency situations, the anticipated response time of off-site medical assistance, and the ability of ambulances or other forms of rescue transport to reach the site of the emergency safely and quickly.

Personnel Requirements and Training - First Aid

ICAO Airport Services Manual Part 1 recommends that emergency response teams be trained for first aid duties using the following guidelines, Part E-2 of the ICAO Training Manual (DOC 7192-AN/857) - Aerodrome Fire Services Personnel. Exact numbers of trained staff are left up to the discretion of management, provided that effective rapid intervention is ensured and equipment use is maximized.

Similar emergency rescue procedures and policies are recommended by the FAA as part of FAR 139.

Transport Canada, as cited in AK-15-01-026, states that the department will assume a leadership role in the organization and training of an employee-based first aid service at federally or privately operated airports, recommending that 1 in 20 airport based employees be certified under the St. John's Ambulance first aid course program, and available on every shift.

Provision of first aid drills as part of overall emergency services training is recommended by each of the three regulatory agencies. Training is to be on-going, with additional medical experience being obtained during annual (minimum) simulated airport emergency drills.

Facilities and Equipment - First Aid

At STOL airports first aid rooms or stations are a basic requirement, their size and complexity being related to a comparable CTOL airport Category 5 type (Transport Canada). According to ICAO, FAA and Transport Canada standards already mentioned, the Canavia operation will require the establishment of one strategically located first aid station -- an exclusive, locked storage cabinet, climate controlled for medical supply storage.

As well, at least one industrial type first aid kit for mobile use is required in addition to those aboard emergency rescue vehicles, passenger transfer buses, and individual aircraft. These kits are to contain supplies approved by agencies such as the Provincial Workmen's Compensation Board as per Treasury Board Standard 3-5 TB698074 dated August 5, 1977.

Provision of adequate signage, portable emergency lighting, emergency services numbers and radio or telephone communication equipment, and adjacent washroom facilities are also suggested.

The following furnishings and supplies are not mandatory for a Category 5 airport but are useful in emergency situations.

- first aid treatment and record book;
- sources of hot and cold running, potable water;
- liquid soap and related dispenser(s);
- disposable towels and related dispenser(s);
- disposable cups and related dispenser(s);
- disposable refuse bags, sterilized gloves;
- chair(s), table, cot, disposable linens;
- collapsible litters and firm backboards, wheelchair(s);
- adequate space, well heated, ventilated, illuminated;
- plastic pails for portable wash-ups in triage area;
- tags for quickly identifying injury severity cases;

- locked storage (safe, or compartment therein) for valuables safekeeping;

- instant camera, films;

- Bible.

9.15 Security Services

Provision is to be made for on-going security protection on site. It is also recommended that security procedures for airport staff be detailed in the site emergency plan.

During and after an incident measures should be taken to protect those in distress from the general public. Specified airport staff should be summoned to pre-appointed security "stations" prior to the arrival of the police to prevent unnecessary access to the airside or proximity to the hazardous area. Selected airport staff not dealing directly with the rescue may be advised of information suitable for dissemination to the media and the public.

Police

No STOLport based police, security guard or commissionaire detachments are envisaged for STOLport sites, however, arrangements for regular patrols, VIP escorts and inspections by city police, similar to those for other transportation facilities are proposed. In the event of an aircraft or other incident police assistance will be summoned as required.

Bomb Threat

If suspicious looking luggage or cargo is encountered, or a verbal bomb threat is implied, airport employees are to assume emergency roles similar to those involving fire and take precautions to clear the hazard area, ready vehicles and equipment and advise off-site police and CFR services of the incident.

Airport staff should not move suspicious materials but may detain suspicious individuals in the interim until policy support is available.

Fencing

The installation of a 2.2m chain link and barbed wire fence per Transport Canada AK 13-12-002 is suggested. Two access points should be available and secured by suitable electronic or manual locking systems.

Fire Training Area

"Hot" drill training at mock up sites and fuel spill lagoons are required unless use of facilities located at nearby international airports can be negotiated. Simulated disasters should, however, be staged on site for familiarity.

Buildings

Accommodation for CFR personnel, vehicles, equipment, and specialized supplies storage is required in proximity to the aircraft movement areas, in order to keep response time to a minimum.

10.0 OPERATIONS CENTRE

10.1 General

The STOL system being researched is assumed to consist of the following major operating components:

- a central administrative headquarters located in one of the three cities being served;
- a downtown check-in terminal in each of the three cities;
- a fully developed STOLport at each city in the system.

The central administration functions would include corporate planning. central reservations, purchasing, accounting, marketing and other corporate activities. The facility would also house the main reservations computer and the central computer for controlling the entire operation.

The downtown terminals would be primarily check-in facilities for passengers and possibly baggage and would be equipped with computer terminals for confirming reservations and for ticket sales.

The operation of the STOLport system within each city would be carried out from an operations centre located on the airport. Employees at the centre would be responsible for managing the following operations:

- airport security including CFR;
- airport operations and maintenance;
- passenger facilities;
- apron services;
- flight operations;
- air traffic control;
- aircraft maintenance;
- STOLmobile/mobile terminal operation;
- communications
- statistics

10.2 Building Requirements

The space requirements for the airport operations centre are based on the assumption that personnel associated with all relevant activities would be accommodated in a single special purpose building. Some operating personnel however would be located in other buildings for reasons of functional efficiency. For example:

- all personnel directly associated with passenger and baggage check-in would be located in the passenger terminal;

- personnel involved in aircraft maintenance, part service, and inventory control would be located within the aircraft hangar;

- the garage foreman and all outside workers associated with airfield maintenance, crash fire fighting and rescue and apron service would be located within a special airport support building.

The space requirements for the operations centre was calculated on the basis of likely peak occupancy and the following assumed commercial office space standards:

Activity	Square Meters/Person
Airport Manager's office	12
Other offices	9
Work stations - maximum	9
- minimum	6
Crew lounge	3
Conference/training	2
Staff lounge (including kitchen)	2.4
Circulation/Gross Up	17.5%

The assumed building occupancy and resulting space is shown on Table 28. The total building area is estimated at 237 square meters: a typical layout for the building is shown on Figure 12.

10.3 Communications

Passenger Operations

It is proposed that mini host computers located in the operations centre of each airport be linked to each other and the central computer by dedicated telephone circuits. These circuits would carry both voice and data transmissions.

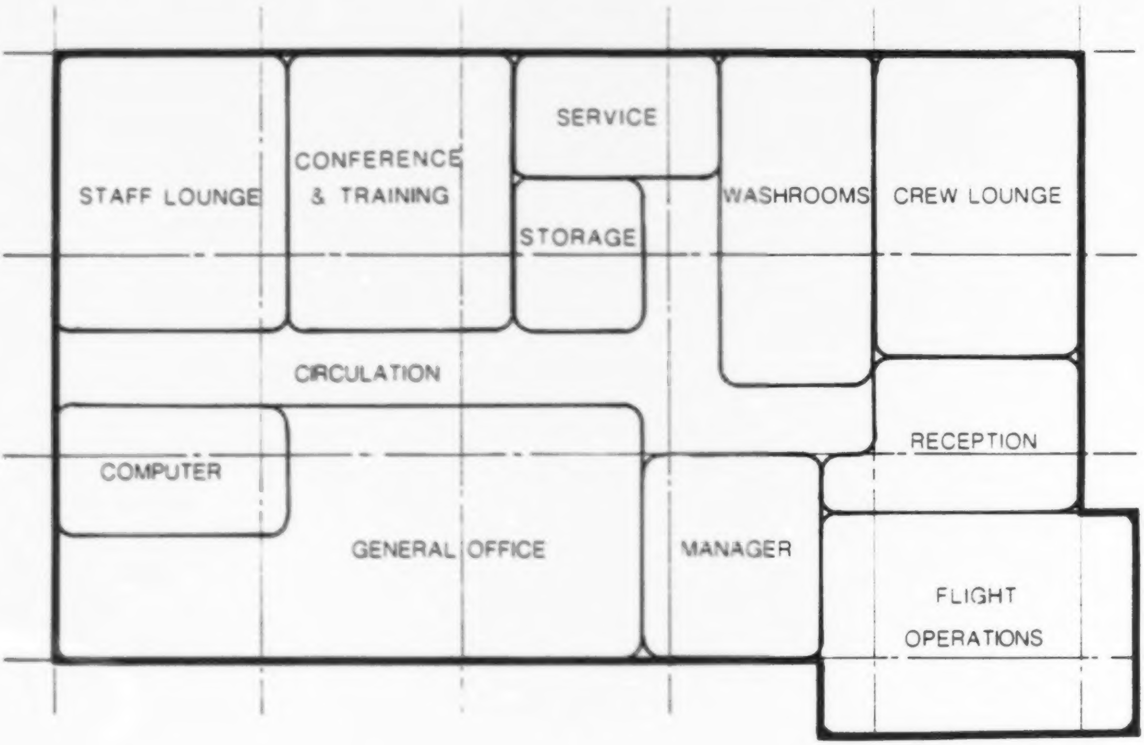
The host computer would handle the following functions:

- passenger reservations;
- flight status reports;
- flight schedules;
- information system and message control;
- STOLmobile status and dispatch;
- operating statistics;
- aircraft maintenance program reports and inventory control;
- staff rosters;
- accounts.

	Fundamental Area	Principle Activities	Personnel	Area Required (Square Metres)
1.	Reception	Control of visitors Secretarial Staff Information	secretary - 1	12
2.	Flight Operators	Communications MET services Crew briefing Flight crew control	radio operator - 1 chief pilot - 1 clerk - 1	25
3.	Crew Lounge	Waiting Meals Relaxation	pilots - 4 attendants - 4	24
4.	Airport Manager	Airport Administration	airport manager - 1	12
5.	General Office	Security control Airfield control Apron services STOLmobile dispatch Statistics Clerical	security - 1 airfield foreman - 1 apron services manager - 1 clerical - 2	50
6.	Computer Room	System Components	operator - 1	10
7.	Conference Room	Meetings Training Emergency	persons - 14	28
8.	Staff Lounge	Kitchen Vending machines Tables/seating	persons - 10	24
9.	Washrooms	Staff & Crew		20
10.	Service & Storage	Building Services Supplies Storage		20
11.	Circulation	Corridors Building Gross Up 17.5%		35
	TOTAL AREA			237

Table 28

Operations Centre Space Requirements


SERVICE
CONFERENCE
& TRAINING
STAFF LOUNGE
STORAGE
WASHROOMS
CREW LOUNGE
CIRCULATION
RECEPTION
COMPUTER
GENERAL OFFICE
MANAGER
FLIGHT
OPERATIONS

SCALE : 4m grid

figure 12

OPERATIONS CENTRE LAYOUT

The proposed method of operation would be to have the central computer control the entire system, each host computer would control the operations at a single airport. The host computers would be programmed to receive and transmit priority information and data pertaining over the entire system on an on-line basis and statistics and accounting information on a batch basis.

Ground to Air Communications

Since the Montreal STOLport will be the only facility in the system completely within the control of the air carrier, its requirements are used to demonstrate prototype requirements for private STOLports in general.

The operations centre will contain a flight operations office manned by qualified personnel. The office will be equipped with VHF air to ground radio transmitters and receivers. Stored flight plans and ATC clearances would be by the Dorval Airport tower on an assigned frequency for two-way transmission between the STOLport runway, the apron surface areas and the control tower at Dorval Airport.

Inter-phone/hotline facilities will be provided between the flight operations office and the Dorval tower as contingency backup to enhance flight safety in the event of communications failure.

Teletype weather circuits would be provided for Dash 7 flight crews by the company.

Dispatchers would be trained by Environment Canada to the company requirements as necessary for the use of PAWRS equipment for weather observations normally found in the hourly MET sequences.

Runway Visual Range (RVR) information would be transmitted to the Dorval tower by telemeter link for transmission to en-route flight crews.

At the time of the study, the understanding was that the MLS landing systems, airfield lighting, airfield electrical centre and the standby power facilities would be provided by Transport Canada and that their operation and maintenance would not form a part of the private operators responsibilities. Since none of the facilities involved require significant buildings, the size of the operations centre is not influenced if this policy were to be reversed.

Intra-Airport Communication

The operations centre would be equipped with a central radio/receiver facility for communicating with ramp and maintenance vehicles operating within the secure area of the airport. All such vehicles would be equipped with mobile radios and would be controlled in accordance with Transport Canada procedures.

11.0 EVALUATION AND APPLICATION OF ALTERNATIVES

11.1 Alternative Layouts

The four alternative STOLport concepts selected for evaluation were described in part 1.3 Methodology. Layouts for these alternatives were developed based on the analyses described in the previous chapters of this report.

The centralized concept where all functions would be housed in a single structure, is shown on Figure 13.

The decentralized concept where each major group of functions would be housed in separate buildings, is shown on Figure 14.

The integrated modular concept where the on-airport functions are grouped in separate facilities within a modularly expandable complex, is shown on Figure 15.

The zero amenity concept where passengers would be processed off the STOLport and transported to and from the aircraft by mobile terminal is shown on Figure 16.

The major facilities shown on the layouts were:

- the aircraft maintenance hangar
- the passenger terminal
- the operations centre
- the airport support facility.

The major variable in total building requirements is the required size of the aircraft maintenance hangar. Analyses by the air carrier showed that the size of hangar needed was highly dependent upon how the aircraft would be assigned to the route and more particularly where they would overnight.

For example, it was proposed that the Ottawa STOLport have two overnighting aircraft, the Montreal STOLport, three overnighting aircraft and the Toronto Island STOLport, four overnighting aircraft. As a consequence, it was determined that initially the Ottawa STOLport would not require a maintenance hangar; the Montreal STOLport would require a single position hangar; and the Toronto Island STOLport a three position hangar.

The costs and site clearances associated with a three position hangar would make it very difficult to integrate it with the smaller low cost buildings required for the other groundside facilities. At the other extreme, the elimination of the hangar over-simplifies the planning process because of the small size of the residual facilities.

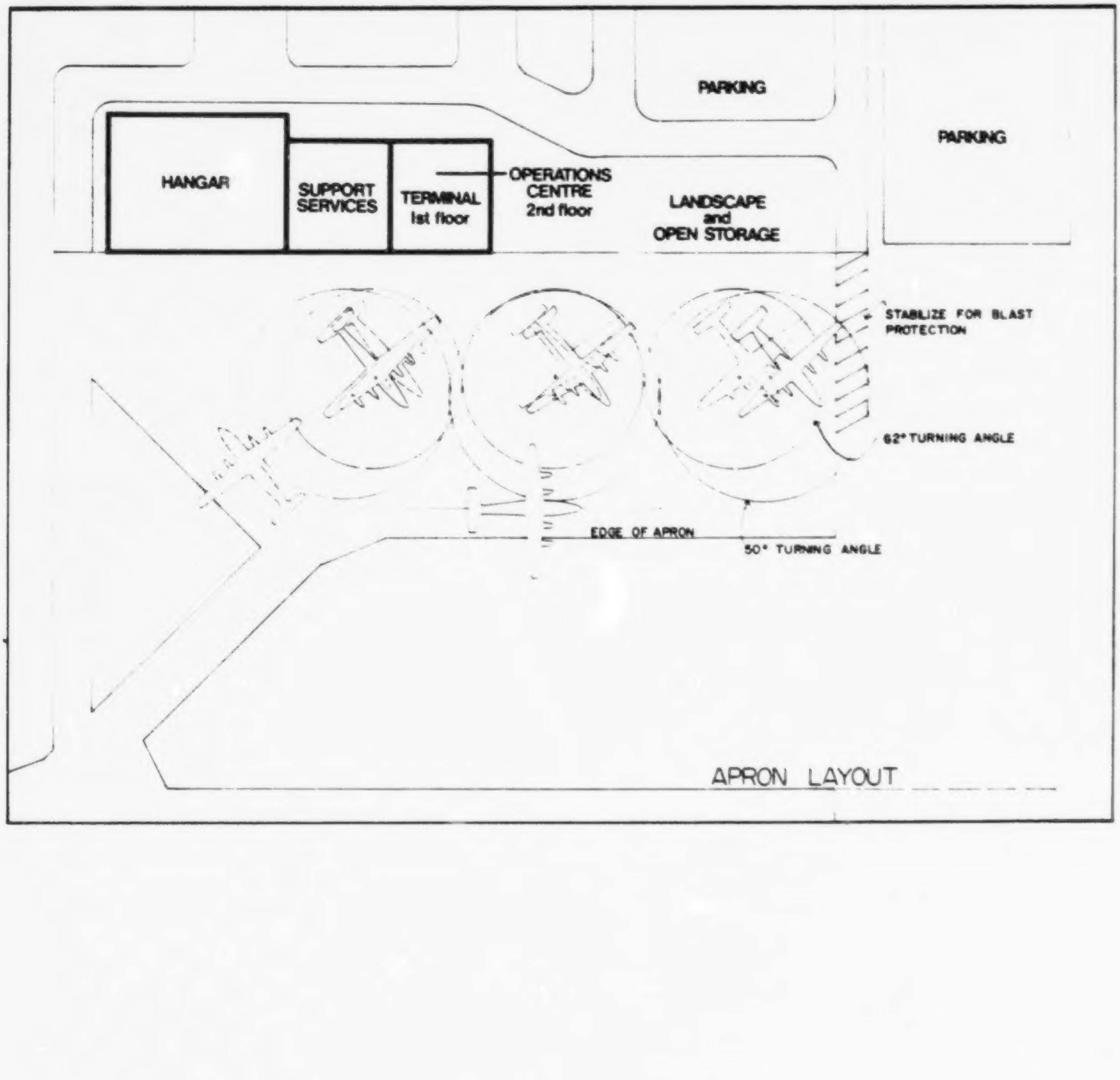

PARKING
PARKING
HANGAR
SUPPORT SERVICES
TERMINAL 1st floor
OPERATIONS CENTRE 2nd floor
LANDSCAPE and OPEN STORAGE
STABLIZE FOR BLAST PROTECTION
62° TURNING ANGLE
EDGE OF APRON
50° TURNING ANGLE
APRON LAYOUT

figure 13

CENTRALIZED STOLPORT CONCEPT

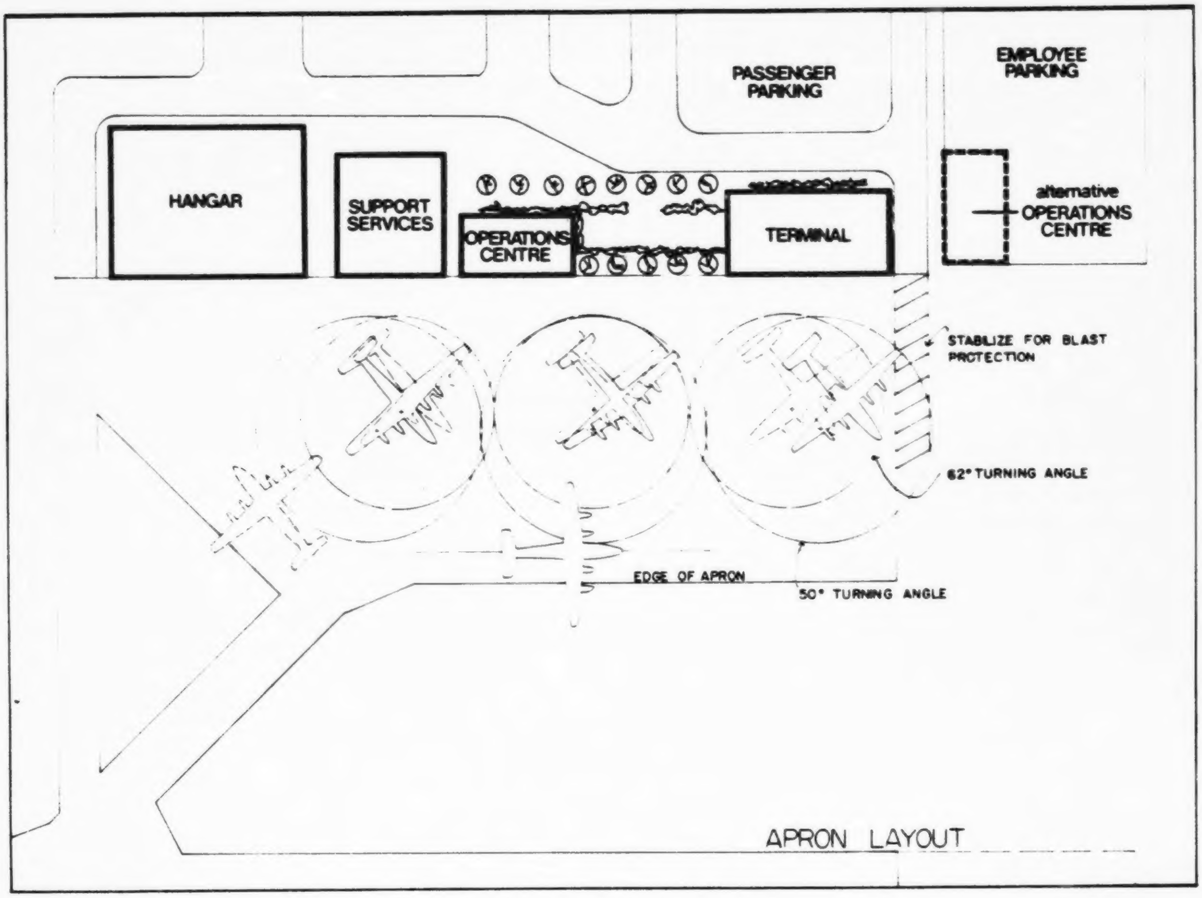
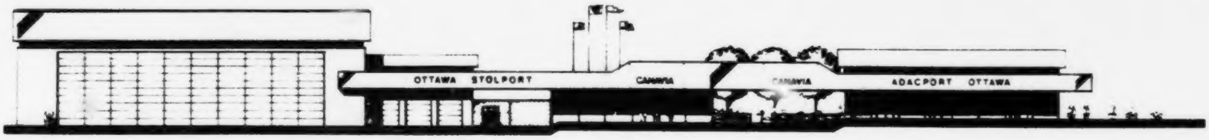
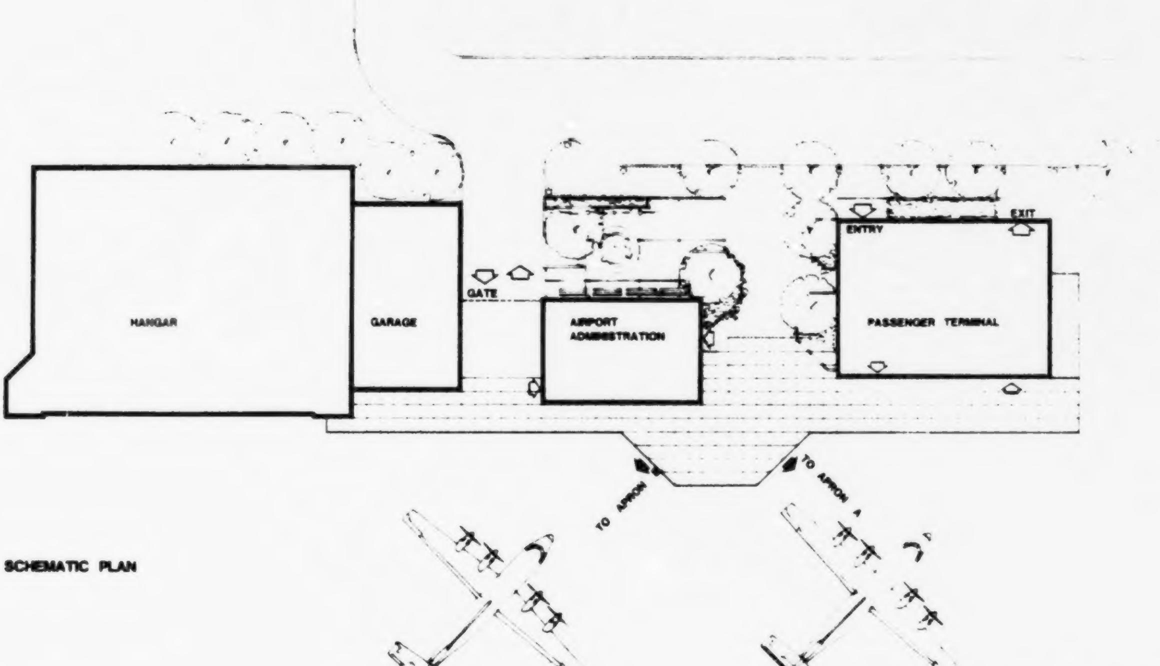

PASSENGER PARKING
EMPLOYEE PARKING
HANGAR
SUPPORT SERVICES
OPERATIONS CENTRE
TERMINAL
alternative OPERATIONS CENTRE
STABILIZE FOR BLAST PROTECTION
62° TURNING ANGLE
EDGE OF APRON
50° TURNING ANGLE
APRON LAYOUT

figure 14

DECENTRALIZED STOLPORT CONCEPT


OTTAWA STOLPORT
CANAVIA
CANAVIA
ADACPORT OTTAWA

ELEVATION


HANGAR
GARAGE
GATE
AIRPORT ADMINISTRATION
ENTRY
EXIT
PASSENGER TERMINAL
TO APRON
TO APRON A

SCHEMATIC PLAN

figure 15

MODULAR STOLPORT CONCEPT

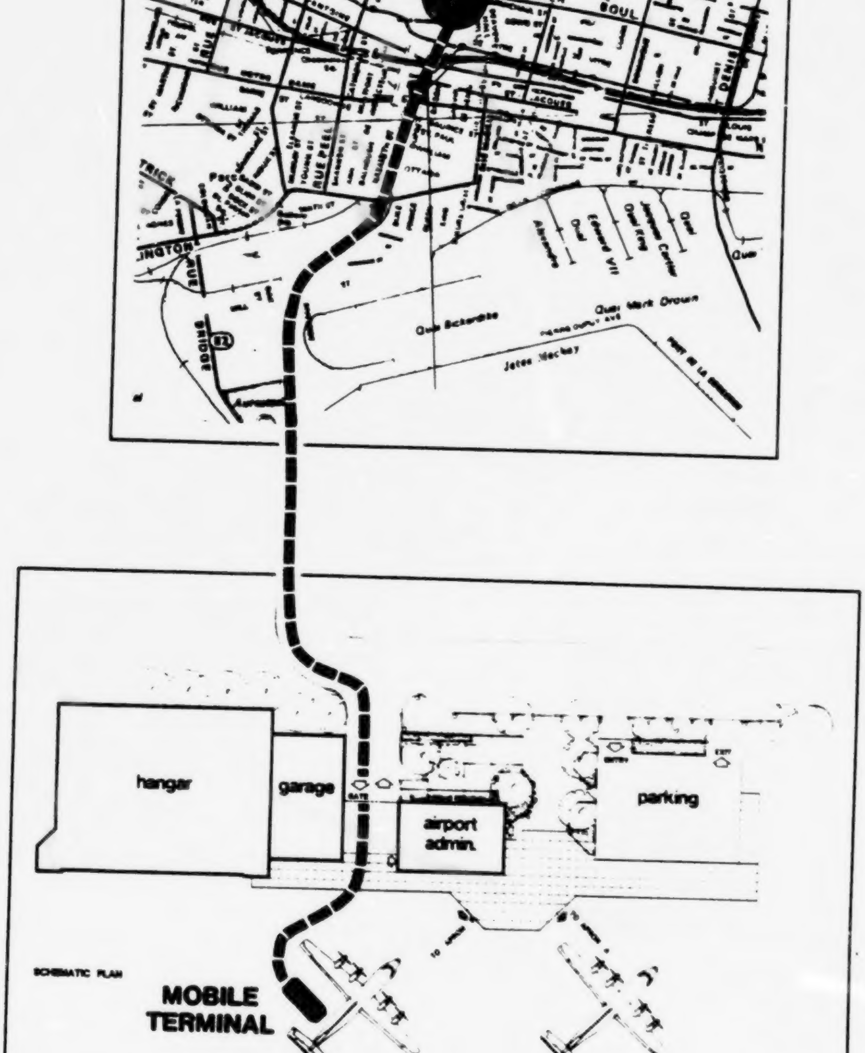

CENTRAL BUSINESS DISTRICT
PASSENGER PICK-UP
ONTARIO
BOUL
BOUL
ST JACQUES
Quai Bickerdike
Quai Mark Drown
Jetee Mackay
hangar
garage
GATE
airport admin.
parking
SCHEMATIC PLAN
MOBILE TERMINAL

figure 16

ZERO AMENITY STOLPORT CONCEPT

For the preceding reasons the layouts prepared for evaluation purposes assume a single position hangar in each alternative. This compromise is believed reasonable and the STOLport shown could form either the operating base for a small STOL carrier operating two or three aircraft or a regional airport for a large carrier overnighting only a few aircraft.

11.2 Building Area Requirements

Passenger Terminal

All four airport concepts assume that the passenger terminal building would be used for passenger processing only; airport administration, airline administration offices, and crew facilities would be housed in a separate airport operations centre. Consequently, the terminal building area required for the centralized, decentralized and modular airport concepts would be identical.

The modular concept envisages a canopy connecting the operations centre and the terminal building and which would provide a sheltered outdoor waiting area for visitors. Theoretically, the area required for public waiting in the modular terminal would be marginally less than that for the other concepts; this factor was not taken into an account because the canopy was introduced for amenity rather than capacity reasons.

The terminal area required would be a follows:

Terminal Type	Area (Square Metres)
- Conventional	444
- Conventional with STOLmobile	363
- STOLmobile (split processing)	292

The zero amenity concept would require the smallest on-airport passenger handling space, of only 130 square metres, an area considered too small for an economical stand-alone facility. The recommended solution would be to provide the passenger space within the operations centre. A number of shared functional areas would then be possible (e.g.):

- the conference and training room could be increased in area to accommodate 50 passengers during long delays and emergencies;
- the staff lounge could be increased in area to double as a food service area for both employees and passengers;
- the staff required for passenger handling could be accommodated by expanding the general office area by one office;
- washrooms and circulation areas could be increased to handle additional temporary loads.

Combining the two buildings would add approximately 60 square metres but the resulting total area of the combined operations centre and passenger space would be approximately 70 square metres less than if the two buildings were provided separately.

Airport Support Facility

The centralized and modular concepts both envisage a combined hangar and airport support garage. The combined structure would be most practical when a single position hangar is involved because the scale of facilities required for the two activities are similar as are their structural requirements. Some operating benefits could also result from combining the two structures by facilitating common staffing of aircraft and vehicle maintenance functions. This would be particularly true if aircraft servicing and maintenance were limited to emergency measures.

Combining the airports support garage with a three position hangar would not be economic because of the disproportionate size of the two buildings and the structural complexities inherent in the large terminal. Also, full scale aircraft maintenance activities would not be compatibile with apron and airport equipment maintenance necessitating that these two functions be kept separate.

The size of the airport support facility is more related to airport size than to airport layout and therefore the same size of facility would be required for all concepts.

Airport Operations Centre

The size of the airport operations centre would not vary significantly between the alternative concepts. The modular concept would allow staff from the terminal building to be assigned to the operations centre for clerical duties during off-peak periods. This would, however, not affect the floor area of the centre since working space requirements would be the same whether the employees were permanently or temporarily employed there.

The size of the centre could be reduced by one or two employee positions under the zero amenity option because of the reduction in airport building areas. The reduction, which would be in the order of 30 square metres, was considered significant in the context of the level of accuracy of the evaluation.

The most convenient physical location for the centre under the modular and zero amenity concepts would be adjacent to the aircraft parking apron where it would be highly accessible to flight crews. In the centralized concept the facility would be located on the second level above the passenger terminal area.

In the modular concept, the facility would be located along the apron and connected to the passenger terminal by means of a continuous canopy. This arrangement would be convenient for passengers, air crew and operations employees, and would allow the development of building areas of different qualities and comfort levels for the three categories of occupants.

The location of the operations centre for the decentralized concept could be either along the apron as for the modular concept or located adjacent the parking lot. The advantage of the parking lot location is that it provides more convenient parking for support and airline employees and also more ground space would be freed for the storage apron equipment adjacent the apron. The disadvantage of this location is that air crew access to and from the aircraft would be less convenient.

11.3 Concept Evaluation

The concepts were evaluated qualitatively on the basis of the following criteria:

- capital cost
- operating cost
- expandibility
- flexibility
- user convenience
- aesthetics

The concepts were ranked in order of their rating for each criteria with the ratings ranging from one to four: the concept ranking highest for a given criteria was assigned a rating of one and the concept considered the worst assigned a rating of four. The results of the evaluation is shown on Table 29.

Criteria	Layout Ranking Centralized	Decentralized	Modular	Zero Amenity
Capital Cost	2 - 4	3	3	1
Operating Cost	2	4	3	1
Expandibility	4	2	3	1
Flexibility	3	2	2	1
User Convenience	4	3	2	1
Aestnetics	3	4	1	2

Table 29 Concept Evaluation

Capital Costs

The zero amenity layout could have the lowest capital costs since no terminal building or passenger parking facilities would be required at the airport. This conclusion is only supportable if the concept did not significantly effect the loading on existing road and parking facilities within the CBD's served.

The centralized layout would be the next cheapest because of savings in building costs and because the land area to be developed would be smaller. The building cost argument only holds true if the utility type construction standards applicable to the hangar and the airport support facility would also be adequate for the passenger terminal and operations centre.

The effect of providing high quality space for the latter two functions including high quality external treatment, could have a spill over effect requiring that the treatment of the two industrial areas also be upgraded. The overall result could be a higher capital cost for the centralized complex than for either the decentralized or modular ones.

The capital cost of the decentralized and modular concepts are believed to be similar. The modular concept has extra construction because of its canopies but the layout is more concentrated and therefore infrastructure costs should be less. The decentralized concept would have the highest infrastructure and related maintenance costs.

Operating Costs

The zero amenity layout should have the lowest operating cost because it requires the less facilities on the airport both in terms of buildings and car parking. It would also have lower building maintenance costs. since the energy requirements and snow removal costs would also be less.

The decentralized layout would have the highest operating cost because it would occupy the larger area and would be also less effective use of operating personnel.

Expandibility

The centralized concept would be the most difficult to expand since all the functional spaces are contiguous within a common structure.

The zero amenity option would be the easiest to expand because it requires the fewest facilities with the least constraint on their location. The decentralized concept would also be relatively simple to expand.

Expansion of the modular concept would be marginally more difficult than the others unless the facility were carefully planned. The area requirements for the airport support garage and the operations centre are more a function of airport size and physical arrangement than traffic demand and so these facilities would not likely require major expansion and could be located at the centre of the development where expansion would be the most difficult to achieve. The hangar and the air passenger terminal could be located at the extremities of the developed area to facilitate expansion.

Flexibility

The criteria of flexibility was introduced to compare the ability of the concepts to respond to future changes in the nature of air passenger demand and aircraft type and operating requirements.

By definition, the zero amenity concept is the most flexible since it requires little or no fixed passenger facilities of the airport. The decentralized layout is the next most flexible since little or no interaction is assumed between the passenger terminal and the other facilities. The centralized layout is the least flexible because modification to one area would most likely effect other areas.

User Convenience

This criteria is primarily intended to measure the convenience of the layouts in terms of air passenger, visitor and air crew use. In this context, the zero amenity layout is the most convenient. The modular and decentralized layouts are similar because in both cases the individual facilities would be designed to accommodate the specific needs of the users. The modular layout is slightly superior in that it could provide greater protection from the environment for both passengers and crew. In both concepts, it would be possible to site the passenger and crew facilities near the apron centroid thereby minimizing walking distances. Both concepts would allow convenient access from parking to the terminal building and the operations centre.

The centralized layout is the least convenient because the location of the passenger terminal relative to both automobile and aircraft parking, would be constrained by the need to accommodate access to other activities within the same structure. There would also be conflict between passenger and employee parking. The need to provide a clear access to the hangar for towed aircraft would require that either the centroid of the operational aprons would be to one side of the passenger terminal building resulting in longer average walking distances, or that an L-shaped apron would be provided. The expansion of an apron having this geometry would be more difficult than of a linear apron.

Aesthetics

The modular layout would have the highest aesthetics since attractiveness was a key factor considered in its development. The decentralized concept requires four buildings each having a different shape and size, different building materials and thus lacks a co-ordinating theme.

11.4 Site Application

Zero Amenity Layout

The zero amenity layout could be applied with equal ease to all three STOLports under consideration because it requires little or no passenger terminal facilities on the airport. Since no significant terminal facilities are available at any of the three sites under consideration, no redundancies would be involved.

Modular Layout

This concept was developed with the Rockcliffe STOLport in mind. The layout has been presented to the National Capital Commission and indications are that in principal it conforms with the development standards pertaining to that airport.

The concept could be adapted in modified form to the Montreal STOLport site but its full advantages could not be realized because it would require partial abandonment of one or more of the existing building floor slabs and foundations which remain from the STOL demonstration project. (The utilization of existing construction is a high priority at this location because of the capital savings involved.)

Toronto Island Airport is already developed and sufficient open land exists only for a new terminal building and for a hangar complex. Provision of an operations centre would not be the responsibility of the STOL carrier and therefore the modular layout would have limited application.

Decentralized Concept

The decentralized concept would not likely meet with the approval of the design committee of the National Capital Commission for aesthetic reasons. The layout, however has potential application to the Montreal STOLport since it would maximize the use of the structures remaining from the STOL demonstration project. The concept could not be implemented in its entirety at the Toronto Island STOLport but its individual components could have application.

Centralized Layout

The centralized layout also would not likely meet the requirements of the design committee of the National Capital Commission for the Rockcliffe site. Furthermore, the layout incorporates a single bay aircraft maintenance hanger which may not be required by the operator on its opening day of the service. This layout would not be cost effective at the Montreal STOLport partly because it is not compatible with the existing foundations, and partly because a building of the size envisaged would be difficult and costly to construct at this location. A centralized building incorporating aircraft hangars, the operations centre and the passenger facilities associated with zero amenity operations would be very compatible with facilities existing facilities at the Toronto Island Airport since the building could be built on a site currently being reserved for hangar construction. Concentrating STOL facilities at a single location would leave the existing passenger terminal available for other operators.

11.5 Observations

The main findings of this study is that:

1. careful consideration should be given to the possibility of utilizing mobile terminals for directly transferring passengers between a central point of origin and the aircraft at STOLports.
2. if conventional facilities are preferred. the integrated modular layout can offer significant advantages particularly in the areas of user convenience and aesthetics. The concept can be inferior to a decentralized one in terms of its expandibility unless the facility is planned with the two facilities having the greatest potential for expansion (the aircraft maintenance hangar and passenger terminal) are located at the two ends of the developed area.
3. the centralized concept incorporating a single bay hangar. is of particular interest for small airports or localities where severe climatic conditions exist and expandibility and flexibility are not major concerns. It can have the lowest capital and operating costs of any of the layouts envisaging full scale facilities at the airport. Its capital cost advantage would be particularly attractive at locations where utility type construction would be acceptable for passenger facilities. A single building would have less exposed wall with considerable savings in building energy requirements resulting. This is particulary feasible for Northern sites.
4. A major factor allowing simplified and more effective passenger handling procedures is the possible non-requirement for security screening for small aircraft operating on domestic routes. Security facilities could be introduced with all the concepts studied in this report with varying degrees of difficulty; with the zero amenity concept would be the most negatively affected.
5. The requirements for groundside support and administrative facilities are more a function of airport size than peak hour traffic demand. Aircraft maintenance hangar requirements are a function of route structure and fleet size. The passenger terminal requirements are the most variable and are influenced by both peak hour traffic and passenger handling system design.

6. Major savings in the cost of providing air crash and rescue services at STOLports might be possible at locations within or close to major urban areas. Careful consideration should be given to the possibility of co-ordinating the on-airport protection facilities with the high quality fire fighting and emergency facilities already available in most Canadian cities.

7. The de Havilland aircraft maintenance program, as developed for the Dash 7, which allows aircraft maintenance to be carried out sequentially in a series of small defined packages during normal overnighting and weekend layovers, appears to offer significant advantages to small carriers over standard block maintenance procedures.

8. The space requirements for storing and repairing airfield maintenance and apron support equipment are largely independent of the level of aviation activities, being more a function of airport size, availability of off-airport equipment maintenance facilities and operator contracting policies.

9. A centralized operators centre accommodating management, air crew waiting and office employee working and amenity space is recommended. The size of this facility is a function of the average annual level of activities rather than peak period demand and would remain constant over a wide range of activity levels.

APPENDIX A

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AK-13-00-028
AK-13-01-001
AK-13-01-002
AK-13-01-003
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APPENDIX C

GLOSSARY OF TERMS

Airside	- refers to all areas on the airfield side beyond airport security fencing which permits restricted access by passengers and airport staff.
Arrivals Entrance also gate also concourse	- is the main airside access point for arriving passengers into the terminal building. This area leads to the arrivals corridor and arrivals lobby.
CBD Terminal	- passenger terminal facility in a metropolitan central business district with bus connections to STOLport (also Downtown terminal).
CTOL	- conventional take off and landing
Deplaning Waiting Area	
Departures Entrance	- Main groundside access point for departing passengers into the terminal building. The area leading to the departures lobby (also Arrivals lounge).
Departures Lobby	- is the main public waiting area of the passenger terminal.
Departures Lounge also Departures Holdroom	- is a separate waiting area for departing passengers only.
Dwell Time	- period of time that a passenger/visitor spends in a terminal facility, including passenger processing time.
Greeters	- those visitors who meet arriving passengers.
Groundside	- refers to all areas beyond airport security fencing which are permitted public access.